

AMERICAN ENGINEER AND RAILROAD JOURNAL.

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NEW "PRAIRIE" TYPE WIDE FIREBOX LOCOMOTIVES.

Simple and Compound.

Chicago, Burlington & Quincy Railroad.

The first engines of this type designed and built by the "Burlington" road (American Engineer, April, 1900, page 103) have rendered satisfactory service both as to the details of the ar-

about 12 tons. In general the details of the frame arrangement, the equalization and the form of the trailing trucks are the same as before, but instead of placing the trailing equalizers under the truck boxes they now rest on top of them, with a saddle and side-motion rollers between. The frame cross-ties and the supplemental rear portions of the frames are substantially as before, to provide for outside journals for the trailing axle. The driving wheels are of the same diameter as before, 64 ins., and the axles are enlarged at the wheel fits.

This is an excellent example of intelligent caution in designing which should be carefully noted. Before ordering a lot of new engines with several novel features this road built a small number (we believe two), and after running them about a year embodied the experience in this present order. Aside from increasing the capacity and compounding a portion of them, the boiler shows the greatest number of changes. The heating surface is increased, but with the same grate area as before. Instead of 16-ft. tubes the new ones are 17 ft. 1 1/4 ins. long, which may be taken as an indication of a tendency toward a gradual lengthening of tubes. With this type the boiler may be kept to a low position, its center being in this case but 8 ft. from the rail level, and yet the depth under the tube sheet is 19 1/4 ins. to the bottom of the mud ring. In the width of the mud ring and the shape of the firebox sides is noted an apparently important feature, to which the wide firebox easily lends itself. At the front water leg the space is 5 ins., and at the sides and back end it is 4 ins. There is perhaps no greater need for circulation space in the wide firebox boiler, but the wide grate renders it so easy to provide greater spaces that this suggestion should be considered. Unless very close figuring on weight is required, there appears to be no reason why these water spaces should not be made even larger, say 6 ins. in front and 5 ins. at the sides and back. This would probably prolong the life of the side sheets and also exert a favorable effect upon the staybolts by increasing their length. In the section of the firebox the sides are very nearly vertical. This also is important, and probably more so with short than with long fireboxes because of its probable effect upon circulation. In a locomotive boiler the



NEW "PRAIRIE" TYPE LOCOMOTIVES, SIMPLE AND COMPOUND—CHICAGO, BURLINGTON & QUINCY RAILROAD.

For Use on the Hannibal & St. Joseph Railroad.

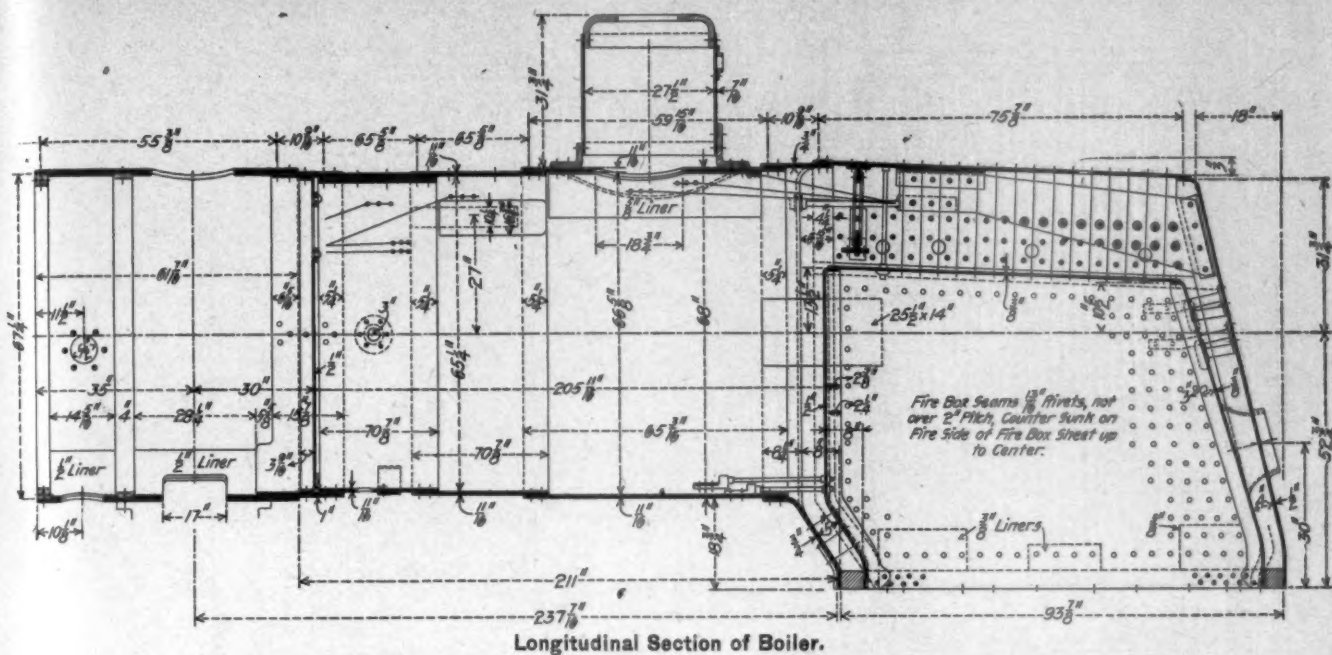
F. A. DELANO, Superintendent Motive Power.

BALDWIN LOCOMOTIVE WORKS, Builders.

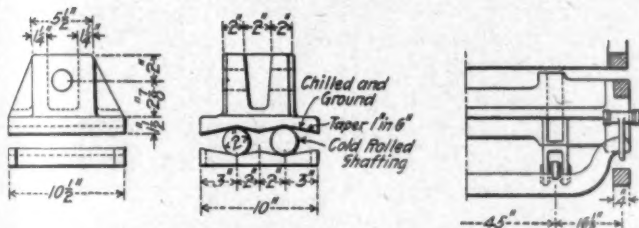
Wheel: Driving	Cylinders: 20 by 24 in.	Boiler pressure	200 lbs.
Weights: Total of engine	64 in.; engine truck	37 1/4 in.; tender wheels	36 in.
Grate area and tubes: Grate area	171,000 lbs.; on drivers	130,000 lbs.; leading truck	14,400 lbs.; trailing truck
Firebox: Length	42 sq. ft.	272-2 1/4 in. 17 ft. 1 in. long	26,000 lbs.
Boiler: type, straight	72 in.; depth of front	60 1/4 in.; back	63 1/4 in.
Heating surface: Tubes	2,732.7 sq. ft.; firebox	155.8 sq. ft.; total	2,888.5 sq. ft.
Wheel base: Driving	12 ft. 1 in.; total of engine	28 ft. 0 in.; engine and tender	54 ft. 5 1/2 in.
Tender: Eight-wheel;	water capacity	6,000 gals.; coal capacity	10 tons.

angement and as to the wide firebox. This has led to the construction of 30 engines by the Baldwin Locomotive Works upon the same plan, with increased size and capacity for use on the Hannibal & St. Joseph Railroad. Six are Vaucain compounds and the rest are simple engines with piston valves. The new design has 20 by 24-in. cylinders, and the weight is increased

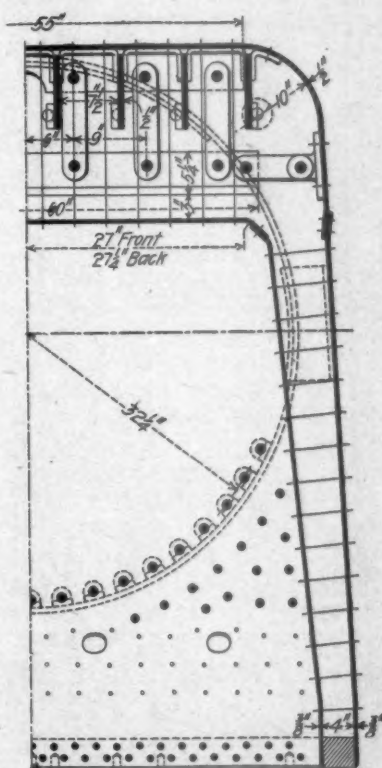
side sheets just below the brick arch are probably the most active heating surfaces, and nearly vertical water legs at these points must necessarily assist circulation by permitting water to pass down on the outside. But this cannot occur if the cross-section is such as to carry the bubbles of steam, moving in approximately vertical lines, against the outside sheet because of



Longitudinal Section of Boiler.



Cross Equalizer and Roller Bearing Over Trailer Box.



Transverse Section of Firebox.

their inclination, and thus cutting off all tendency for the water to come down on the outside. This may be found to be important in connection with wide fireboxes, even more so than with narrow ones, but it seems wise to also provide as far as possible for the natural course of circulation from the bottom of the water space by using wide mud rings.

The simple and compound engines are built to the same general specifications, but the frame arrangements at the front ends are made to suit the conditions of each type. In the compounds there are three bars at the cylinder, the lower section in front of the cylinders being in a plane different from the others. The following table presents the chief characteristics of both types:

Prairie Type Freight Locomotives. Chicago, Burlington & Quincy Railroad.

Cylinders—Simple Engines.

Diameter	20 ins.
Stroke	24 ins.
Valves	Piston

Cylinders—Compound Engines.

Diameter (high pressure).....	16 ins.
Diameter (low pressure).....	27 ins.
Stroke	24 ins.
Valves	Piston

Weights.

Weight on leading truck.....	14,400 lbs.
Weight on drivers.....	130,000 lbs.
Weight on trailers.....	26,000 lbs.
Total weight	171,000 lbs.

Boiler.

Diameter	66 1/4 ins.
Thickness of sheets.....	11/16 in.
Working pressure	200 lbs.
Fuel	Soft coal

Firebox.

Material	Steel
Length	84 ins.
Width	72 ins.
Depth	Front, 66 1/4 ins.; back, 63 1/4 ins.
Thickness of sheets.....	Sides, 3/8 in.; back, 1/2 in.; crown, 1/2 in.; tube, 1/2 in.

Tubes.

Material	Iron
Number	272
Diameter	2 1/4 ins.
Length	17 ft. 1 11/16 in.

Heating Surface.

Firebox	155.3 sq. ft.
Tubes	2,732.7 sq. ft.
Total	2,888.5 sq. ft.
Grate area	42 sq. ft.

Driving Wheels.

Diameter outside	64 ins.
Diameter of center.....	56 ins.
Journals	9 by 10 ins.

Engine Truck Wheels.

Diameter	37 1/2 ins.
Journals	6 1/2 by 9 ins.

Trailing Wheels.

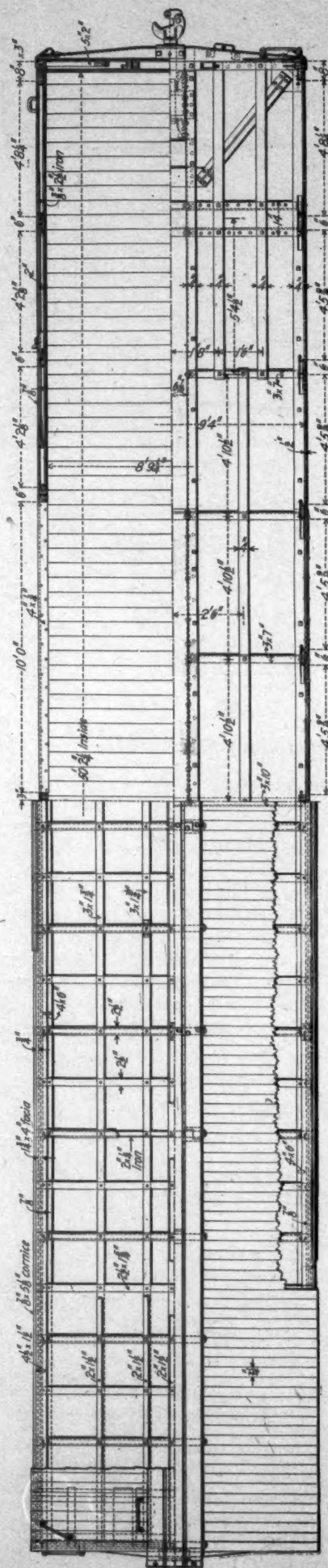
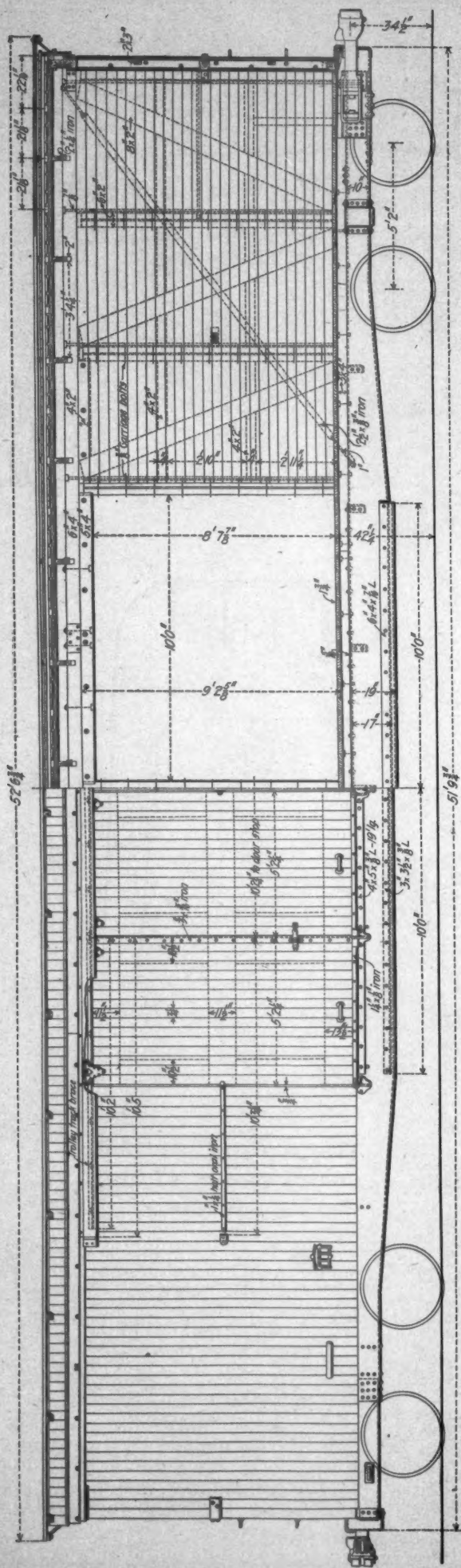
Diameter	37 ins.
Journals	6 by 10 ins.

Wheel Base.

Driving	12 ft. 1 in.
Rigid	12 ft. 1 in.
Total engine	28 ft. 0 in.
Total engine and tender.....	54 ft. 5 1/2 ins.

Tender.

Diameter of wheels.....	36 ins.
Journals	5 by 9 ins.
Tank capacity	6,000 gals.



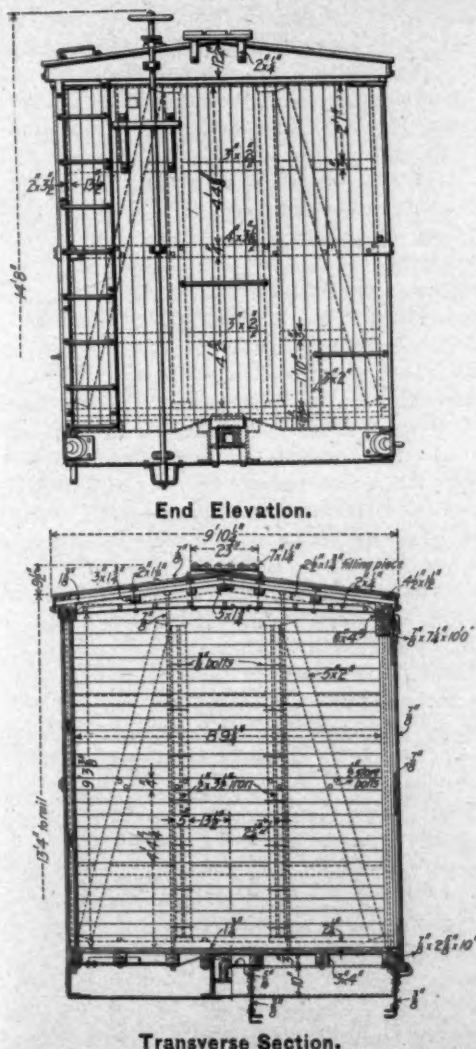
Fifty-Foot Furniture Car, with Steel Underframes—Erie Railroad.

PRESSED STEEL CAR COMPANY, BUILDERS.

A. E. MITCHELL, Superintendent Motive Power.



Fifty-Foot Furniture Car, with Steel Underframes—Erie Railroad.



Transverse Section.

With locomotive cylinders exposed as they are to the effects of low temperature and winds of high velocity, it seems but natural that they should be protected in the best possible way from loss of heat which is much more effective at the cylinders than in the boiler. Attention has repeatedly been directed in these columns to the importance of this protection and it is hoped that before long greater care will be exercised in lagging cylinders, steam chests and saddles with the best material available. A large two-cylinder compound gave a great deal of trouble last winter in an atmosphere 50 degs. below zero Fahr., and failed to do one-half its rated duty because of this loss of heat.

FURNITURE AND BALLAST CARS.

Pressed Steel Car Company.

FIFTY-FOOT FURNITURE CAR WITH STEEL UNDERFRAME. ERIE RAILROAD.

Last month, on page 107, a 40-ton box car with steel underframing, designed and built for the Union Pacific Railway by the Pressed Steel Car Company, was illustrated. A number of adaptations of the same general plan have been made for cars of various types, one of which, a 50-ft. furniture car, for the Erie Railroad, is illustrated by these drawings. This car has four pressed steel sills of the "fish-bellied" type, 17 ins. deep at the center and reinforced for a distance of 10 ft. each side of the center by a 4 by 6-in. pressed steel angle riveted to the lower portion of the web of each sill. At distances of 4 ft. 5 9/16 ins. between centers pressed steel channel lateral floor beams are riveted between the side and center sills to support the wooden stringers. Other details of the floor construction are shown in the drawings. In this car the corners are braced by angles at the floor and the box structure has angle braces of 2 1/2 by 3/8 in. iron drawn up between the outside stringers and the side plates by nuts. On each side there is a 10-ft. door 8 ft. 7 7/8 ins. high in the clear. The doors are double on each side of the car and "staggered" to permit of loading long material, long wagons or boats. The doors on each side come to the center line of the car as indicated in the side elevation and longitudinal section. This arrangement and the unusual width of the openings will be very convenient. The roof construction is also indicated in the drawings. In this design the underframe carries the entire load with no assistance from the upper structure.

ERIE RAILROAD FURNITURE CAR. General Dimensions.

Length over end sills.....	51 ft. 9 3/4 ins.
Length inside of body.....	50 ft. 3 5/16 ins.
Width over all.....	9 ft. 10 1/4 ins.
Width inside.....	8 ft. 9 5/16 ins.
Height, rail to top of running board.....	14 ft. 1 in.
Height, rail to brake shaft.....	14 ft. 9 ins.
Height, rail to top of center channels.....	3 ft. 3 1/2 ins.
Height, rail to bottom of center channels at bolsters.....	2 ft. 5 1/2 ins.
Height, rail to center of couplers.....	2 ft. 10 1/4 ins.
Distance between centers of trucks.....	40 ft.
Size of journals.....	4 1/2 by 8 ins.
Wheel base of trucks.....	5 ft. 2 ins.
Centers of journals.....	6 ft. 3 ins.
Light weight of car.....	40,400 lbs.
Capacity.....	80,000 lbs.

These cars are carried on Fox pressed steel trucks with 33-in., 600-lb. wheels. They have cast iron journal boxes, Westinghouse brakes, solid pressed steel brake beams made by the Pressed Steel Car Company, and the standard twin spring draft gear of these builders. The cars are equipped with double sliding doors with Q. & C. fixtures and the Dayton



Fifty-Ton Ballast Car—Union Pacific Railway.

Malleable Iron Company's door fasteners. They also have end doors at the brake shaft end of each car. The roofs are covered with the Winslow galvanized roofing.

FIFTY-TON BALLAST CAR. Union Pacific Railway.

This car is of a unique design intended to deal with 50 tons of coal or 55 tons of ballast. It has two doors extending along each side of the full length of the bottom of the car body. These are operated in unison by a single operating shaft through the medium of a toggle lever which also operates a spreader device. This arrangement is controlled from one of the end platforms of the car, where a lever is placed on the end of the operating shaft, and the doors may be opened as much or as little as desired, while they may be closed positively at all times. In the photograph the exterior appearance of the car is shown, and also the bracing and the arrangement of the air brake cylinder and reservoir. The car is fitted with wooden extension side and end pieces which are secured to the permanent steel sides by means of removable stakes having U-shaped guides open upon the top and of such dimensions that the boards may be easily slipped in and out. Chains attached to the boards prevent them from falling to the ground when they are lifted out of the guides. This arrangement will be convenient when loading with coal, as the extension pieces may be put in place after the load has reached the level of the permanent sides. The following table gives the chief dimensions:

General Dimensions.

Length over end sills.....	40 ft. 0 in.
Length inside body.....	32 ft. 7 1/4 ins.
Width over all.....	9 ft. 4 ins.
Width inside of body.....	8 ft. 8 1/2 ins.
Height from rail to top of body.....	8 ft. 3 ins.
Height to top of brake shaft.....	5 ft. 5 1/2 ins.
Height to top of center sills.....	3 ft. 3 1/2 ins.
Distance between truck centers.....	31 ft. 1 in.
Size of journals.....	5 1/2 by 10 ins.
Wheel base of trucks.....	6 ft. 6 ins.
Center of journals.....	6 ft. 5 ins.
Weight of car empty.....	37,000 lbs.
Capacity loaded with coal.....	100,000 lbs.
Capacity loaded with ballast.....	110,000 lbs.

Fireproof Stairs.—Consul General Guenther, of Frankfort, Germany, reports that on March 3 official tests of so-called fireproof stairs for apartment houses were made at the yards of one of the fire department stations in Frankfort, where intense fires had been started for the purpose. The stairs covered with plastering showed the longest resistance, and could still be used after being subjected to the fire for twenty-five minutes. Of stairs coated with fireproof paints, no tangible results could be stated, as the stairs experimented with were of great variety as to material and strength; but they were still serviceable after five or ten minutes under fire. Of the wooden stairs without fireproof paints, those of oak withstood the fire the longest.

LARGE POWER PLANT OF THE MANHATTAN RAILWAY,

New York City.

The new power station of the Manhattan Elevated Railway, New York City, will furnish electric power for the third-rail system and will displace about 225 locomotives, which last year consumed 226,924 tons of coal and 535,000,000 gallons of water. The huge proportions of this plant are made apparent by the immediate demand that will be placed upon the generators when the motive power of the road is changed from that of steam locomotives. This demand, including the lighting and heating of the trains and stations, is estimated at 60,000 electrical horse power. Each of the eight dynamos is rated at 5,000 kilowatts, and, according to "Power," they are capable of delivering at maximum load, 7,500 kilowatts or an aggregate of 80,000 electrical horse power.

The station is conveniently located near the water front of the East River, between 74th and 75th streets, and is built in the form of a trapezoid 413 ft. long on one side and 395 ft. on the other, with a uniform width of 204 ft. It is of steel construction with brown-tinted Pompeian brick walls resting on a granite rock base 26 ft. high above the foundations. The windows are 14 by 45 ft., spaced 35 ft. apart on all sides of the building. The roofs are of red tile with copper-covered monitors and the chimneys are of buff-colored brick. The station is divided longitudinally into a boiler and engine house, the latter containing a basement and main floor and the boiler house a basement and two floors devoted to the boilers and overhead coal storage. Two longitudinal division walls in the basement of the boiler house separate the pumping machinery in a central section by itself.

A 50-ton electric crane serves the main engines, and two electric cranes span the space occupied by the exciter engines.

In the engine room are eight 8,000 h.p. units furnished by the E. P. Allis Co. and are the largest units ever constructed for this kind of work. These units consist of two compounds with 44-in. horizontal high-pressure cylinders and 88-in. vertical low-pressure cylinders, with a stroke of 60 ins. and a speed of 75 revolutions per minute. The use of four cylinders and cranks placed 135 degs. apart give a turning effort sufficiently uniform to permit of dispensing with fly-wheels. The revolving field of the generator being 32 ft. in diameter and weighing about 170 tons, is sufficient to give the necessary inertia effects. Four direct-connected tandem compound engines, built by the Harris Foundry & Machine Works, are used to drive the exciters. The high-pressure cylinders are 15 ins. in diameter and the low-pressure 25 ins., with a stroke of 18 ins. These engines run at 200 revolutions per minute. A separate Worthington condenser is used for each unit. Three vertical single-acting air pumps are attached to cranks set at 120 degs. upon

a shaft operated at a speed of about 30 revolutions per minute, by a gear-connected motor. The pump cylinders are 45 by 18 ins., giving a displacement of 1,491 cu. ft. per minute, at 30 revolutions. The electric current will be generated at the main power station by three-phase Westinghouse generators, at a potential of 11,000 volts, and transmitted along three 3-in. conductor cables to seven sub-stations, where it will be transformed by step-down transformers and rotary converters to direct-current of 625 volts, for transmission to the third rail.

In the boiler plant are 64 Babcock & Wilcox units with an aggregate capacity of 32,000 h.p. Each unit has 5,243.28 sq. ft. of heating surface, and 88 sq. ft. of grate area, giving a ratio of grate area to heating surface of 1 to 59½. The boilers are designed to carry 200 lbs. pressure, and are arranged in four rows of 16 boilers each and fed by Roney stokers; the coal being piped from the overhead storage to the stokers. The economizers used in connection with the boilers are 16 in number, every four boilers being provided with an economizer. Four chimneys, 278 ft. high, together with 16 Sturtevant blowers, will furnish the draft for the 56 boilers. These blowers are 9 ft. in diameter, 4 ft. 6 ins. wide and run at 180 revolutions, with a capacity of 57,000 cu. ft. of air per minute, and will be used only for cases of emergency where it is necessary to force the boilers beyond their capacity with natural draft. The chimneys are for a height of 73 ft. above the foundation, octagonal in section, 26 ft. 6 ins. in diameter, with walls 5 ft. thick. Above the octagonal base the shaft is circular in form, varying in thickness from 32 to 8½ ins. The coal is carried by gravity bucket conveyors from a coal and ash tower erected on the river front, to the storage bins located directly over the boilers. These bins are W shaped in section and divided into three bunkers, separated from each other by an air space 35 ft. in width. The capacity of the bunkers is 15,000 tons of coal sufficient for 20 days' run. A separate conveyor is used for the ashes, which are chuted from the ash pits into dump cars and hauled by an electric locomotive to the ash hopper where they are delivered to a bucket elevator and carried to the storage bins in the tower and thence chuted into barges. The capacity of the ash storage is 1,200 cu. yds. This tower is also equipped with an automatic shovel and a coal-crusher. The coal after being crushed passes over the weighing scales into a cross-line conveyer which delivers it to the main line conveyor running to the coal bunkers. All the hoisting, crushing, weighing and conveying apparatus is operated by direct-connected motors.

The work of this plant is under the general supervision of Mr. W. E. Baker, who will be remembered as having built the Intermural railway at the Columbian Exposition, in Chicago. Mr. E. D. Leavitt and Mr. L. B. Stillwell were engaged as consulting engineers. The general engineering work is in charge of Mr. George H. Pegram, Chief Engineer of the Manhattan Railway Company.

That there is a need of some recognized system of classifying locomotives is conveniently shown in a table which appeared in the April issue of the "Railroad Digest." The existing forms of wheel arrangement are classified in this table into the "Bogie" class, with four-wheel leading trucks; the "Pony" class, with two-wheel leading trucks; the "Switching" class, without a leading truck, and the "Forney" class, both with and without a leading truck. There is a logical system in these series, if the trailing wheel is not considered, but there is nevertheless an uncertainty as to the exact meaning of the type names used. These various types are also designated in a separate column of the table, by Mr. F. M. Whyte's method, which is a system of classifying that includes the whole wheel arrangement. Mr. Whyte's system is given on page 375 of the December, 1900, issue of the American Engineer and Railroad Journal and fully explained in a communication by Mr. Whyte in our issue of February, 1901, page 55, with a criticism by Mr. G. S. Edmonds in the January paper, page 21. Mr. F. F. Gaines also describes a system that not only defines the type of the engine, but gives an idea of its size and capacity. This description will be found on page 119 of the April, 1901, paper.

STEAM JETS TO STOP CLINKERING.

Admission of steam in jets into fireboxes for the improvement of combustion was practiced years ago for the purpose of mixing the gases in order to bring oxygen into intimate contact with the combustible gases. Jets of air were used for the same thing, but owing to the cooling of the furnace by the heat absorbed by the steam and that required to heat the air the resultant economy has not appeared to be great. It is possible, moreover, to have a large excess of air in the firebox and yet find a large amount of combustible gases pass off unconsumed because of imperfect mixture if the air is admitted above the fire. Unquestionably the best place for supplying air is through the grates and the fire and if there are no holes in the fire the mixture of gases is sure to be good. While steam which is admitted above the fire appears to rob the furnace of some of its heat, it does not appear likely that it will do so when admitted below the grates, and experience with automatic stokers indicates that steam admission under the grates will be worth trying on locomotives. It seems to prevent the formation of clinkers and this is a serious matter in automatic stokers. It is serious also in locomotives. The writer recently saw a mass of clinker from a locomotive firebox large enough when broken up to fill a bushel basket. Coal containing relatively large proportions of sulphur seems to give the most clinker, while some coals are free from it. The theory of the action of steam under the grates is that of dissociation in passing through the fire and the hydrogen liberated from the oxygen combines with the sulphur to form hydrogen sulphide; or, in other words, the sulphur is disposed of in a gas instead of a solid. Experiments recently made on a locomotive seem to confirm this reasoning for there has been in this case a great improvement as to the formation of clinkers.

To enlarge the opportunity of engineering students for the study of railroad problems, Purdue University has made two important changes in the course of Mechanical Engineering. Heretofore all students have during their senior year taken steam engine design, followed by general engineering design. Along with this general course will be given hereafter a course in car and locomotive design with the privilege of electing either course. The second is an additional required subject extending over a period of twenty-two weeks of the senior year. Three recitations a week will be called for, on the subject of electric power transmission dealing largely with the mechanical engineering side of power stations, of transmission lines and of motor installations. This offer of options to students in the later years of their course is practiced only by two or three of the larger technical colleges of the country and is a matter the students themselves would like to see encouraged. It might be a means of correcting some of the failures of technical graduates in the first years out of college. In many of these schools the men are educated to be professional engineers, when they really feel that they are best fitted for some particular kind of work, but without optional courses offered to them they are not given a specialty or an opportunity to study one. Some of these young men when started into practical work are not at first successful. They may take to their choice later, but it is after a large amount of shifting about and with a great deal of dissatisfaction. It is no longer a draftsman that is wanted by a railroad, but a good man to do elevation work, a man to be a fuel expert or to take up some specialty. A general course of technical training is beneficial no matter what the life work may be, but the proper preparation of a few students out of a class of many is not what is wanted so much as the education of many along the lines of their own interests and personal inclinations. These optional courses are good in themselves and it is believed that they help graduates to get into the lines of work they are best fitted for. They may, on the other hand, serve to indicate work which one is not fitted for, and that is equally important.

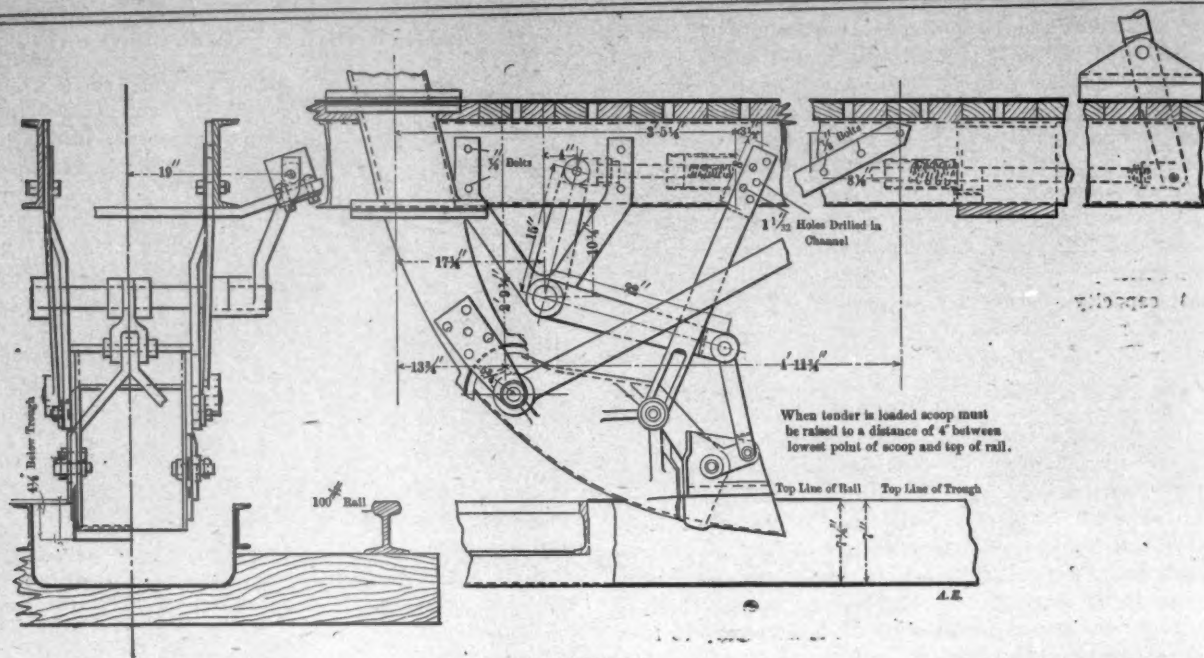


Fig. 1.

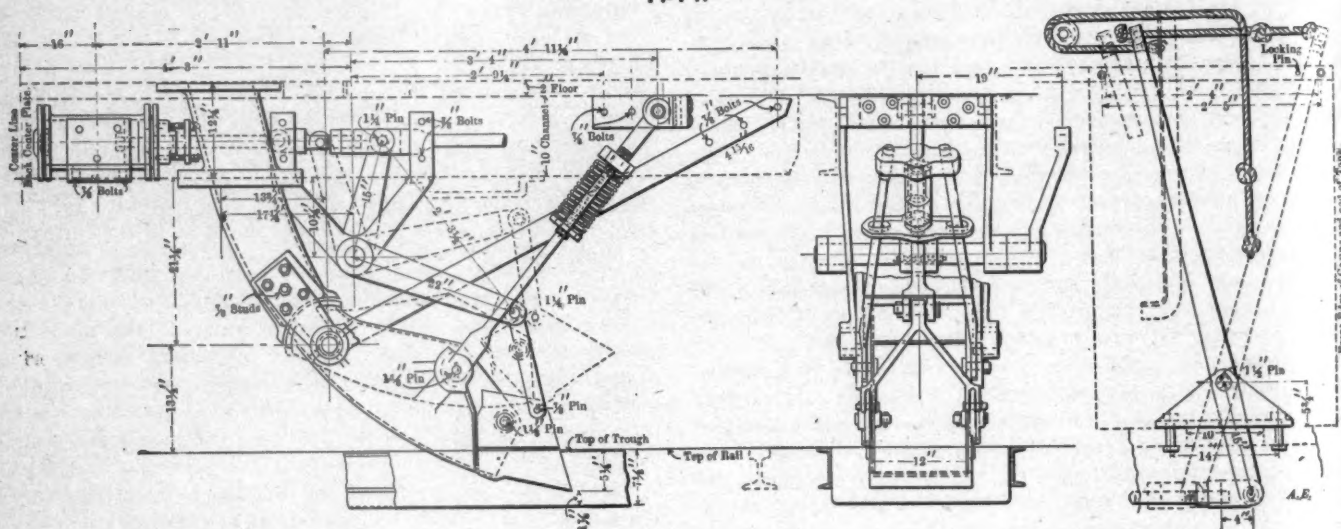


Fig. 2.

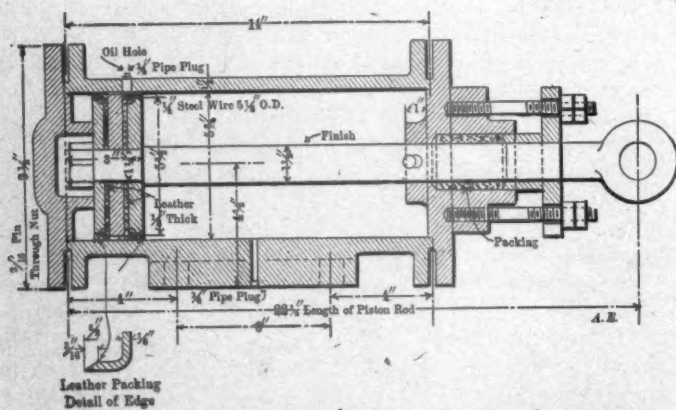


Fig. 3.

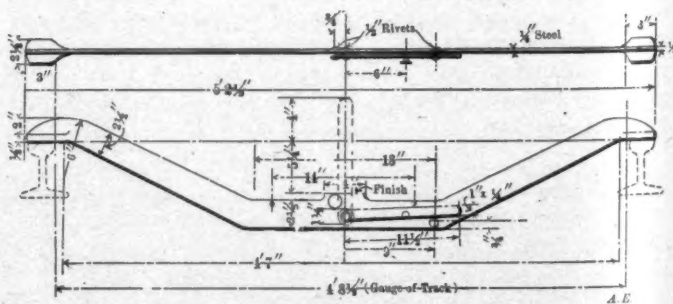


Fig. 5.

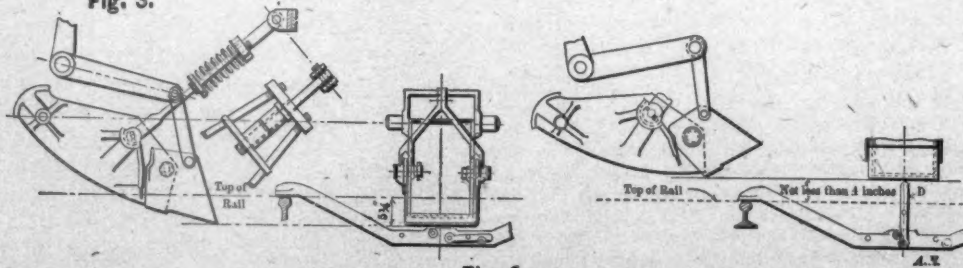


Fig. 6.

New Track Tank Water Scoop—New York Central & Hudson River Railroad.

A NEW TRACK TANK WATER SCOOP.

For Freight and Passenger Locomotives.

New York Central & Hudson River Railroad.

Two interesting designs of track tank scoops have been brought out recently, the one on the Lake Shore & Michigan Southern, designed by Mr. H. F. Ball, Mechanical Engineer of that road, and the one illustrated in this description, designed by the motive power department of the New York Central. For the present drawings we are indebted to Mr. A. M. Waitt, Superintendent of Motive Power and Rolling Stock.

The designs are alike with respect to the provision for raising the scoop against the resistance of the water at high speed, the lower ends being made with two movable joints, but the construction and actual method of raising are quite different in the two arrangements. It becomes very important to provide properly for the thrust of water, for the horizontal thrust is considerable. We recently heard an amusing account of a test at high speed with a light engine (no train), the resistance of the water being great enough to retard the engine considerably when the scoop caught the water. Without the inertia of the train back of the tender the lifting of from 5,000 to 6,000 gallons of water in a few seconds, which represents foot pounds of work with a vengeance, slowed the engine down.

To permit of drawing the scoop out of the water against such resistances the New York Central plan, like that of the Lake Shore, employs a very short section for the dipper itself. The object being to first tilt the portion which has the least horizontal thrust upon it. The mouth section, which presents very little curved area to the water, is tilted first, and when the bottom plate of the dipper is tilted upward and forward the water striking the underside of the dipper assists in lifting the entire scoop. In the New York Central design the dipper section has stops in the lower hinge, which come to a bearing when the mouth is tilted upward and the further movement of the dipper section takes the second section along with it until the raising movement is completed.

We present two engravings of the New York Central scoop, showing two arrangements which are different in the details

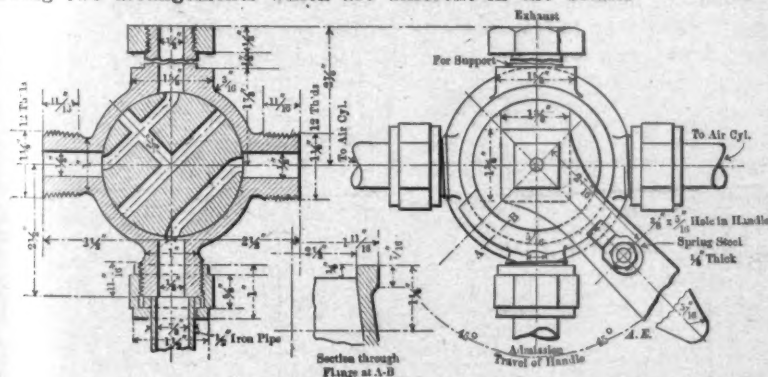


Fig. 4.

of suspension and in the arrangement of the stops in the links for limiting and controlling the action of the mouthpiece. Both are operated by air pressure, although the cylinder is shown only in Fig. 2, and both may be operated by hand, the form shown in Fig. 2 being the latest design. In Fig. 1 the links limiting the lower position of the second section are slotted and their upper ends are made adjustable in the attachment to the tender frame. In Fig. 2 the links act through the coil springs, which have three functions, to cushion the stopping of the scoop, to interpose a slight resistance to the main part of the scoop insuring the entering of the cutting edge into the water first and to assist in raising the scoop from the trough. If anything except the spring connection break, the scoop will be raised from the trough by the incline at the end of the

trough and will be supported above the rails by the springs. The thimble stops inside of the springs determine the lower position of the scoop. This attachment also provides for adjustment of the height of the scoop.

In this design no machine fitting of the scoop itself is required. The mouthpiece is left open on top in order to prevent splashing and to take advantage of the wave raised by the scoop as it passes through the water. An air cylinder and operating valve complete the apparatus. These are also illustrated. The valve is a 4-way cock with ports arranged to "bleed" both ends of the cylinder to the exhaust, to permit of operating the scoop by hand when necessary. In Fig. 4 the main air pipe is at the bottom of the drawing, the exhaust at the top and the cylinder admissions at the right and left sides. The handle of this valve is left in the middle position when the scoop is not in use. To lock the scoop the movement of the hand operating lever is blocked by a pin which must be removed before the air valve is operated.

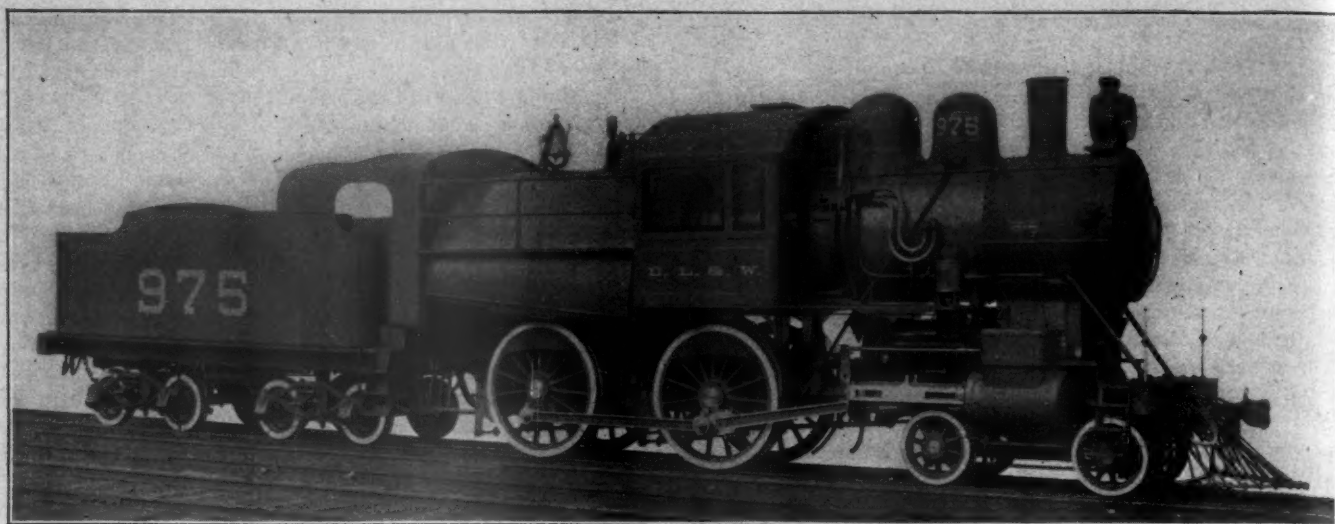
It has been found necessary to provide a systematic method of adjusting the scoops with reference to the troughs and for this purpose the gage shown in Fig. 5 was devised. This is used as indicated in Fig. 6. When the scoop is down to its lowest point it is adjusted to be not more than $5\frac{1}{4}$ ins. below the top of the rail and this distance is provided for in the shape of the gage. When raised, the lowest point is kept at least 4 ins. above the rail level and this is measured by the swinging arm of the gage, as indicated. It is the practice of this road to inspect all the scoops every week and keep them closely adjusted.

Those who are designing water scoops in the future will find the Kiesel scoop of the Pennsylvania Railroad, illustrated in this journal in November, 1896, page 283, and the Lake Shore scoop in November, 1900, page 344. These, with the present description, bring this subject up to date and show what is believed to be the best practice.

Removal of Old Paint.—Numerous recent fires caused by the use of painters' naphtha torches have called urgent attention to this hazard. Carelessness on the part of the mechanics is, without doubt, a necessary adjunct to the torch in producing such fires; for by ordinary care in handling the torches ignition could certainly be avoided. Under the trade name of "Clyzol," a solution has been put upon the market in Paris for the purpose of removing old oil paint. If this solution is applied to a painted surface of wood or iron, upon which there may be even as many as fifteen or twenty coats of old oil paint, a saponification of the oxydized oil of the paint is effected which may be washed away in water, leaving the wood or metal clean. It is not even necessary to wait for the solution to dry, since, after it has been in contact with the paint for about ten minutes, a stream of water is sufficient to wash the whole away. Clyzol has been adopted by the Paris Omnibus Company among other large users, and would seem to have a wide

application in the cleaning of rolling stock and large iron structures before repainting. Many of the beautifully carved old oak doors in Paris, which at some period of bad taste had been painted, are now being cleaned with Clyzol and refinished in their natural state. Clyzol presents no fire hazard in its presence or use, and should be substituted for the present extremely hazardous processes of removing old paint by the use of gasoline flame, or the application of benzine or other volatile solvents.—Insurance Engineering.

It is surprising to be told that compressed air under a pressure of 100 lbs. per square inch will leak through a $1/16$ -in. hole at the rate of a horse-power every five minutes or 12 horse-power per hour. Mr. W. P. Pressinger made this statement before the New York Railroad Club recently, in order to emphasize the importance of tight piping and reservoirs.



EIGHT-WHEEL, WIDE FIREBOX PASSENGER LOCOMOTIVE—DELAWARE, LACKAWANNA & WESTERN RAILROAD.

T. S. LLOYD, Superintendent Motive Power.

SCHENECTADY LOCOMOTIVE WORKS, *Builders.*

	Cylinders: 20 and 26 in.	Boiler Pressure.....	185 lbs.
Wheels: Driving.....	69 in.;	engine truck.....	33 in.
Weights: Total of engine.....	138,000 lbs.;	on drivers.....	94,000 lbs.
Grate area and tubes: Grate area.....	87.67 sq. ft.	Tubes.....	280 2 in. 13 ft 4 1/2 in. long.
Firebox: Length.....	126 in.;	width.....	100 in.
Boiler: type, straight.....	radial staying.	depth of front.....	57 in.;
Heating surface: Tubes.....	1,947.9 sq. ft.;	firebox.....	195.4 sq. ft.
Wheel base: Driving.....	8 ft. 6 in.;	total of engine.....	23 ft. 3 in.;
Tender: Eight-wheel:	water capacity.....	5,000 gals;	coal capacity.....
			10 tons;
			weight empty.....
			48,150 lbs.
			tender wheels.....
			total engine and tender.....
			188,150 lbs.
			back.....
			46 in.
			Diameter.....
			61 in.
			total.....
			2,143 sq. ft.
			engine and tender.....
			50 ft. 1 1/4 in.

EIGHT-WHEEL, WIDE FIREBOX PASSENGER LOCOMOTIVES.

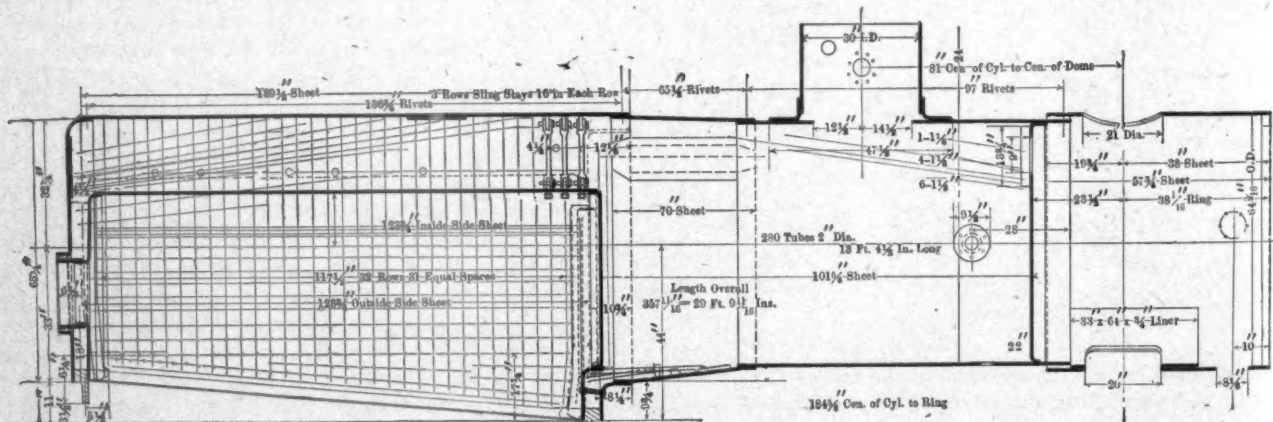
Delaware, Lackawanna & Western Railroad.

Built by the Schenectady Locomotive Works.

The peculiarities of the fuel to be burned are now considered important in determining the proportions of fireboxes, even when the coal is very cheap, as it is on the Delaware, Lackawanna & Western. Mr. Lloyd has made a careful study of the action of anthracite of the smaller sizes and has found it possible to secure important savings in culm burning. These new engines have larger grates than those of the very large

who are taking the first steps in the adaptation of wide grates to bituminous coal burning.

This is the heaviest engine of this type of which we have record. The heating surface has been exceeded, but the operation with six-car trains over the mountain grades and about 40-mile schedules, is so satisfactory as to indicate a successful result. For this service sufficient tractive weight is obtained with four coupled drivers and with the excellent though small-sized coal it was not considered necessary to use the Atlantic type. In the details great care was used to simplify in every possible way to avoid breakdowns. The driving journals are 9 by 13 ins., and with 197 lbs. per square inch load these do not run hot. Mr. Lloyd has adopted shaking grades for all wide



Longitudinal Section of Boiler.

10-wheel passenger engines built last year for the same road (American Engineer, September, 1900, page 272), although the new ones are of the 8-wheel type. These grates, with an area of 87.67 sq. ft., are giving excellent results, indicating that the proportions are correct for the conditions. Readers will also remember the culm-burning switching engines built by the Dickson Locomotive Works (March, 1901, page 91). These engines are all designed with reference to the use of various mixtures of fine anthracites, and in this respect the policy of the mechanical department of this road is suggestive to those

firebox engines and finds them very satisfactory. There will soon be nine of these engines in service. They are known as Class 19C. We shall have more to say about these engines later.

Eight-Wheel, Wide Firebox Passenger Locomotive. Delaware,
Lackawanna & Western Railroad.

General Dimensions.

General Dimensions.	
Fuel	Fine anthracite coal
Weight in working order.....	138,000 lbs.
Weight on drivers.....	94,000 lbs.
Weight on truck.....	44,000 lbs.
Wheel base, driving.....	8 ft. 6 ins.

Wheel base, rigid.....	8 ft. 6 ins.
Wheel base, total.....	23 ft. 3 ins.

Cylinders.

Diameter of cylinders.....	20 ins.
Stroke of piston.....	26 ins.
Horizontal thickness of piston.....	54 ins.
Diameter of piston rod.....	3½ ins.
Kind of piston packing.....	Plain rings
Size of steam ports.....	18 by 1½ ins.
Size of exhaust ports.....	18 by 3 ins.
Size of bridges.....	1½ in.

Valves.

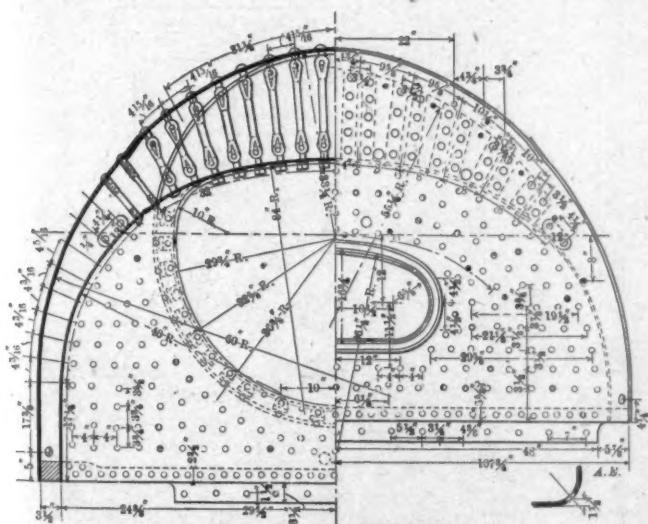
Kind of slide valves.....	Allen-Richardson balanced
Greatest travel of slide valves.....	5% in.
Outside lap of slide valves.....	1/2 in.
Inside clearance of slide valves.....	1/2 in.
Lead of valves in full gear, forward.....	1/16 in.

Wheels, Etc.

Diameter of driving wheels outside of tire.....	39 ins.
Material of driving wheel centers.....	Cast steel
Tire held by.....	Shrinkage
Driving box material.....	Cast steel
Diameter and length of driving journals.....	9 ins. dia. by 13 ins.
Diameter and length of main crank pin journals.....	6 ins. dia. by 6 ins.
Dia. and length of side rod crank pin journals.....	4½ ins. dia. by 4 ins.
Engine truck, kind.....	Four-wheel rigid center
Engine truck journals.....	6¾ ins. dia. by 12 ins.
Diameter of engine truck wheels.....	33 ins.
Kind of engine truck wheels.....	Allen No. 7 cast iron spoke center, with 2½ in. tire

Boiler.

Style	Straight, with wide firebox			
Outside diameter of first ring.....	61	ins.		
Working pressure	185	lbs.		
Thickness of plates in barrel and outside of firebox,	19/32 in., 1/2 in., % in., 11/16 in.			
Firebox, length	126	ins.		
Firebox, width	100	ins.		
Firebox, depth	57	ins.	F, 46 ins. B.	
Firebox plates, thickness.....	Sides, % in.;	back, % in.;		
	crown, % in.; tube sheet, 9/16 in.			
Firebox, water space.....	Front, 4 ins.;	sides, 3 1/2 ins.;	back, 3 1/2 ins.	
Firebox, crown staying.....	Radial stays, 1 1/4 in. diam.			
Firebox, stay bolts.....	1/2 in. diam.			
Tubes, material	Charcoal iron No. 12 B. W. G.			
Tubes, number of.....	280			
Tubes, diameter	2	ins.		
Tubes, length over tube sheets.....	160 1/2	ins.		
Heating surface, tubes.....	1,947.87	sq. ft.		
Heating surface, firebox.....	186.40	sq. ft.		
Heating surface, total.....	2,143.27	sq. ft.		
Grate surface	87.67	sq. ft.		
Grate, style	Rocking, in 6 sections			
Ash pan, style.....	D, L. & W. style, with cast iron bottom			
Exhaust pipes	Single			
Exhaust nozzles	4% ins.; 5 ins., 5% ins. dia.			
Smokestack, inside diameter.....	17 1/2 ins. and 16 ins.			
Smokestack, top above rail.....	15 ft. 0 in.			
Boiler supplied by.....	Hancock Composite Inspirator No. 10			



Section of Firebox.

Tender.

Weight, empty	48,150 lbs.
Wheels, number of .....	.....
Wheels, diameter	33 ins.
Journals, diameter and length	5 ins. dia. by 9 ins.
Wheel base	16 ft. 9½ ins.
Tender frame	10-in. steel channels
Water capacity	5,000 U. S. gals.
Coal capacity	10 tons
Total wheel base of engine and tender	50 ft. 11½ ins.

Special Equipment

Westinghouse-American combined brakes on drivers, tender and for train.
Leach sand feeding apparatus.
Gollmar bell ringer.

Water tube boilers of the type used by the English navy, the Belleville, fared badly at the hands of a committee recently appointed by the admiralty to investigate the subject. While the report was adverse to the Belleville boiler, recommending that no more be used in that service, it must not be understood as a condemnation of water tube boilers in general. The Belleville boilers are known to be an improvement upon the cylindrical type, but the Belleville does not represent the highest attainment in water tube boilers. It has been surpassed by others. This is the accepted significance of the report. The criticism seems to turn on the point of durability, a most important factor. There seemed to be a strong feeling in the minds of the committee favorable to the Babcock & Wilcox boiler, but there was no intimation of a desire to return to the old tank boiler. The experience illustrates the importance of thorough trials on a small scale before entering into a wholesale adoption of any type of marine boiler.

As to the theoretical economy in superheated steam there is no doubt, and from continued practical use of superheaters there is shown an actual saving of from 10 to 25 per cent. There are, however, three practical difficulties arising from their use, which were brought out in the discussion of a paper on "Superheated Steam," by Mr. E. H. Foster, at the April meeting of the Junior Members of the American Society of Mechanical Engineers. First, the destruction of lubricants and stuffing boxes. Second, the difficulty in not being able to keep the steam at a stated temperature. Third, the extra cost of a plant, for piping, special joints, etc. The first has with the use of mineral oil been practically overcome, as also has the failure of packings and stuffing boxes. The second difficulty is experienced more in locomotives, where the temperature will at times fall below that of the temperature of the steam in the boiler and again run up very much higher, burning the flues. The author's experience in testing superheating plants in Great Britain and upon the Continent, that have been in continued use from 6 to 10 years, led him to believe that 135 deg. F. was as high as steam should be superheated and that the first 20 degs. is the most effective. The jacketing of cylinders is considered unnecessary if the steam is superheated sufficiently to pass through the cylinder without waste in condensation. Cast-iron has been used very extensively for superheaters with no trouble of burning out at temperatures as high as 650 degs. F. More has been done in other countries in developing the superheater than in the United States and the general sentiment of those familiar with such plants in Germany, England and elsewhere that have been in continued use is, that they are generally considered successful.

In using new materials there is a strong tendency to follow precedents of form which were employed in the materials previously used for the same parts. For example, cast-steel locomotive frames have generally been made exactly like wrought iron frames without consideration of the fact that it would be advantageous to change the form to suit the peculiar characteristics of cast steel. On another page of this issue appears a design for a cast-steel frame. It is offered for criticism by a student and we hope our readers will express their opinions. Probably few will approve of casting the frame in a single piece, but that is a minor matter in view of the ease with which it may be changed. The shape of the cross-section is the chief point of interest, and while there may be a variety of opinions as to what shape is best suited to the material, few will insist that a rectangular section is correct. Severe condemnations of cast-steel frames may be heard from those who have used them, while others speak as plainly in their praise. It is safe to say that the design has much to do with the failures, and if this suggestion leads to a consideration of the character of cast steel and its behavior in cooling, the object for which it is printed will be accomplished.

LOCOMOTIVE AND CAR SHOPS.

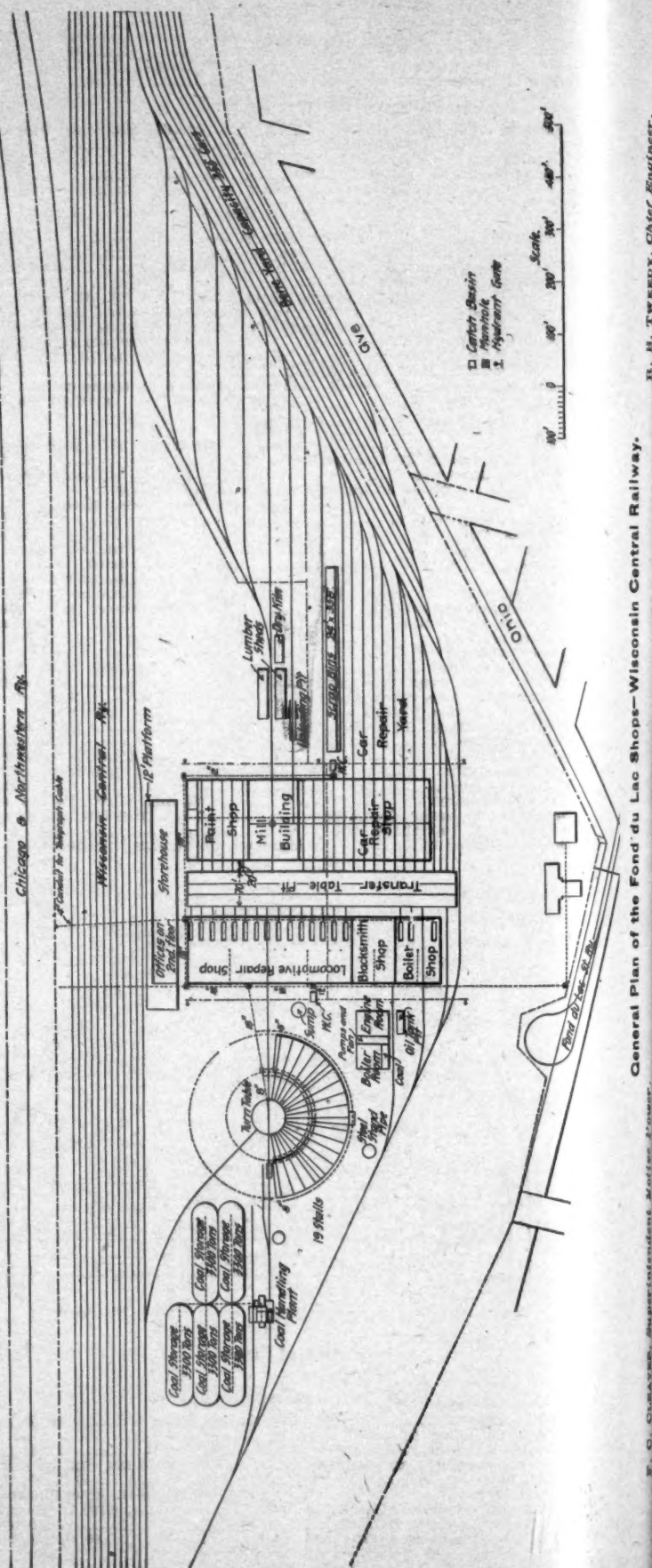
Wisconsin Central Railway,

Fond du Lac, Wisconsin.

We are indebted to Mr. F. C. Cleaver, Superintendent of Motive Power; Mr. R. B. Tweedy, Chief Engineer, and Mr. Angus Brown, formerly Superintendent of Motive Power of this road, for information concerning the attractive new shops just completed at Fond du Lac, Wis. The original shop plant of the road was at Stevens Point, and in 1889 the locomotive department moved to Waukesha, near Milwaukee. These plants were nearly 160 miles apart, and when it became necessary to provide increased facilities, Fond du Lac was selected, because it is 156 miles from Chicago, and permitted the road to be operated in three divisions. (1) Chicago to Fond du Lac; (2) Fond du Lac to Abbotsford, and (3) Abbotsford to Minneapolis. All the heavy repair work will now be done at Fond du Lac, the Waukesha shop will be maintained, but that at Stevens Point will be abandoned and the machinery taken to the new plant. At Fond du Lac the heavy work on 150 locomotives and 10,000 cars will be done.

A large tract of land was secured, about 3 miles from the center of Fond du Lac, and near Lake Winnebago in a location which is favorable for building a shop town. It is bounded on one side by the main line of the road, with the Chicago & Northwestern track parallel to it. The compact arrangement of the buildings is seen in the ground plan. There are three principal buildings, a locomotive shop 507 by 128 ft., and a car shop 481 by 160 ft. with a 70-ft. transfer table between, and at one end of the transfer table is the storehouse, a building with a three-story end, the upper part being occupied by offices. The plan also shows the location of the round house, coal storage plant (to be built later), the power house, and also the lumber sheds, dry kiln, scrap bins and car repair yard. This plan also indicates the location of the drains, the locker house at the entrance to the grounds and beside it a proposed club house for the employees. The water closets are near the large buildings and the washing facilities are in the locker house through which all the men pass on their way to and from work. All clothing is kept in the lockers and none is permitted to be left in the shops. The locker house is fireproof, with 600 metal ventilated lockers. The urinals are located in the shops at the center posts. They have running water and are cased in wood with doors. Instead of the usual wide space between the transfer table and the buildings on each side of it, this plan shows spaces of 20 ft. only. When locomotives are fired up for testing they are taken to the tracks at the end of the car shops where the smoke and noise of blowing pops will not inconvenience the shop or office forces and with such narrow spaces, at each side of the transfer table, there will be no temptation to litter up the short tracks outside the buildings. The buildings are of light-colored brick and very attractive. The roofs are all supported by steel trusses and steel posts.

Electric distribution is provided throughout and the power house was located where it was wanted, without reference to the other buildings. It contains two Allis-Corliss engines, one of 150 and the other of 350 h.-p. The small engine has a 16 by 42 and the larger one a 24 by 42-in. cylinder. The smaller engine is considered an auxiliary for lighting the shops, yards and station and will also be used for such over-time work as may be necessary. It drives a 100-kw. generator. The large engine has two fly wheels, taking belts for two 100-kw. generators. Three, 72 in. by 18 ft. cylindrical boilers furnish steam, the draft being secured by the Sturtevant system of forced draft used in connection with a stack which extends but 20 ft. above the roof of the building. In order to estimate the power requirements intelligently the engines at Waukesha were indicated and an allowance made for about 20 per cent. more power than at present required. All the steam and water pipes except



General Plan of the Fond du Lac Shops—Wisconsin Central Railway.

R. B. TWEEDY, Chief Engineer.



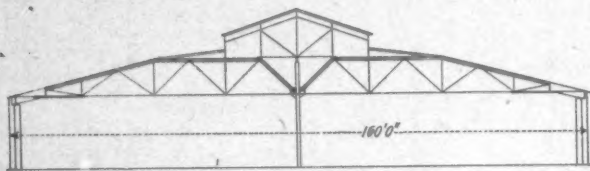
General Plan of the Ford and the Envelope



General Plan of the Ford and the Envelope

the return steam pipes are overhead in the buildings and the outside steam pipes are overhead. The buildings are heated by the Sturtevant hot air fan system.

In the locomotive department a track runs through all the shops with a small turntable in the middle of the main shop, connecting with the round-house track. This building provides for 15 pits in the erecting shop and over them the roof trusses are shallow enough for two 30-ton rope-driven cranes which were brought from Waukesha. On the other side of the center posts two 5-ton cranes serve the heavy machinery, while a two-ton crane serves the benches. The provision for the cranes and the supports for the line shafting are shown in the sectional sketch of this shop. The line shaft is divided into three sections for the group system of driving. There are four groups in this shop, the wheel machinery, the tool room and the main portions of the shop machinery. A 40-h.-p. motor drives each section of the main shaft, and the tool room is driven by a

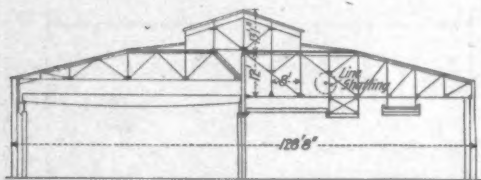


Section Through Car Repair Shop.

10-h.-p. motor, all of which are mounted overhead upon the roof trusses. Two 30-h.-p. motors in this shop drive the Sturtevant fans and two more drive the air compressors which are fitted with automatic devices for regulating the pressure. There are no individual motors on the machines of this shop.

Adjoining the locomotive shop, and separated from it by a brick wall, is the blacksmith shop, 88 ft. long. A 15-h.-p. motor drives the tools and another of the same size drives the fans, both being carried on the roof trusses. The blast is brought to the forges underground and the smoke is conducted from the 18 fires to three turrets of 6 fires each and is carried away by three stacks. The large forges and the steam hammers are served by boom cranes.

Another 88 ft. section is devoted to the boiler shop with a brick wall partition between it and the blacksmith shop. It has three pits, a through track to the transfer table and the necessary machinery driven by a 20-h.-p. motor and a single



Section Through Locomotive Repair Shop.

line shaft. Outside the building and opening into it is the flue rattler.

In the car department the machinery is grouped in the mill portion, which is 100 ft. long and driven by a 15-h.-p. motor, the only other motor in this building being one of 40 h.-p. for the fan system. There are 13 tracks in the car repair shop, and five in the paint shop. At the end of the building three rooms are partitioned off for upholstery, paint mixing and varnishing. For convenience the axle and wheel work for the car department is provided for in the mill, and it is served by a track from the outside of the building.

The transfer table is 70 ft. long and is driven by a 50-h.-p. motor, which is capable of driving it at almost 5 miles an hour with its load. In the round house there are at present 19 pits, but the extension of this, and, in fact, all of the buildings, is provided for. The turntable is 70 ft. long and it is to be driven by a motor.

Among the details worthy of notice is the arrangement of "Dutch" doors in all of the shops. The lower portions may be

opened to pass a truck and material without opening the entire door. All the roofs have 5-ply tarred paper, and far with a heavy coat of gravel on top. The drainage of the grounds is admirable, as the elevation above the lake is nearly 20 ft. The main drain is 30 in. in diameter and the two branches 18 and 12 in. The roof drainage runs into 8-in. sewer pipes. These are placed in ditches about 5 ft. deep and 3 ft. wide, placed near the walls and filled with broken stone. No ice was found around the round house last winter, indicating the value of this method. The water supply is obtained from a 360-ft. well situated between the round house and erecting shop. From this the water flows through a siphon into a 30 by 30-ft. reservoir. The siphon is of 5-in. pipe and dips 30 ft. into the well and the same distance into the reservoir. It comes up to within 4 ft. from the surface of the ground. Special care was taken to secure light through a plentiful supply of skylights and clerestory windows. There are two lines of skylights on each side of each of the large buildings.

A description of the power house has been reserved for a subsequent article, when we shall fully describe the machinery in connection with the power house.

ALUMINUM AT PARIS EXPOSITION, 1900.*

The five international exhibitions held in Paris, since the first, in 1855, have served as landmarks in the history of aluminum. It made its first public appearance in the shape of a bar, lying on black velvet in a glass case, and labeled "L'argent de l'argile," "the silver from clay." That bar probably cost more than its weight in gold. The exposition of 1867 found an established industry to be represented. The metal was being sold commercially at the rate of \$12 a pound and to the quantity of 1,000 kilograms (1 long ton) a year. The important alloy with copper-aluminum bronze was then shown for the first time. In 1878 the exhibition marked only a moderate expansion of the industry. The yearly output had nearly doubled, but the selling price was the same. The 1889 exhibition marked a period of revolution in the industry. The yearly output had increased to 71 tons and the selling price of the pure metal had decreased to less than \$5 per pound; in fact, that very year it fell to nearly half that figure. The last year of the century finds the industry upon an entirely different basis. From an annual production of 70 tons it has risen to the relatively enormous figure of 7,000 tons; from a price nearly \$5 a pound to the almost incredible figure of 30 cents. Aluminum is now as really a metal of every-day life as silver, nickel, mercury, copper, brass, tin, zinc, lead or iron, though not to the same degree as several mentioned. In the United States, in 1898, only pig iron, copper, lead and zinc were produced in greater quantity than aluminum, and only pig iron, copper, lead, zinc, silver and gold surpassed it in value of output. When we wish to make a given object in metal, it can be made cheaper in aluminum than in anything else, excepting zinc, lead or iron; brass, copper and all the other metals are dearer.

It is said that the late Ulrich Eberhardt, the head of the firm of Gould & Eberhardt, machine tool builders of Newark, N. J., was made foreman of the shop while an apprentice and receiving but \$3.50 per week in wages. He spent his whole career in that one concern and never had a strike or any labor trouble.

Forced lubrication, consisting of pumping a circulation of oil to the bearings of stationary engines, was the subject of a recent discussion before the Manchester Association of Engineers. "The Engineer," in reporting the proceedings, mentions a 100-horse-power engine running at 450 revolutions per minute, night and day, for two years without any difficulty. In this case oil was forced into the bearings at a pressure of 25 lbs. per sq. in.

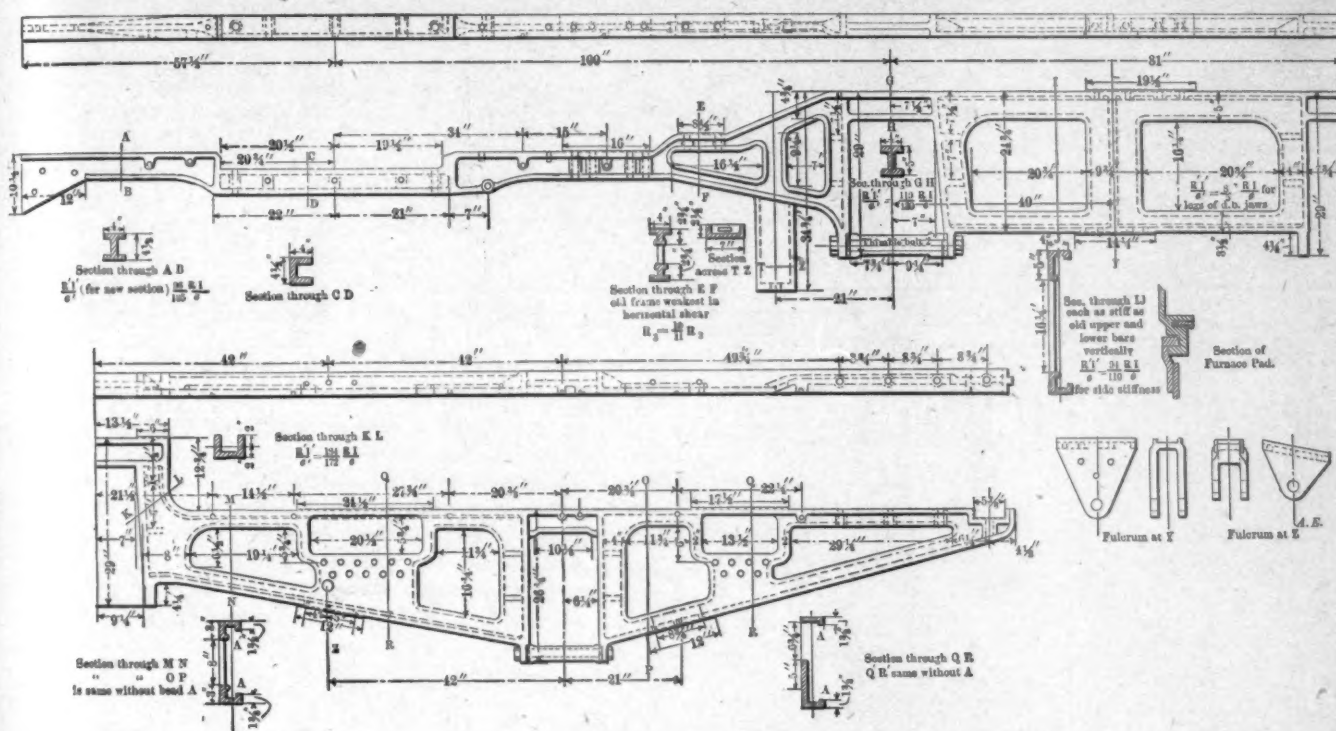
*From a paper by Prof. Joseph W. Richards, in Journal of the Franklin Institute.

A SUGGESTION IN CAST-STEEL LOCOMOTIVE FRAMES.

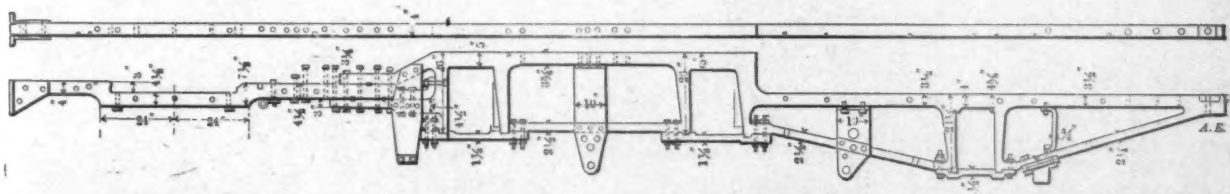
HOT-BLAST HEATING.

The cast-steel frame shown in the accompanying drawing was designed to replace an ordinary wrought-iron bar frame of a locomotive on a western road. Cast steel being a plastic material, the object was reduction of weight and advantageous distribution of metal, keeping in mind ease in casting, freedom from cores, and uniform thickness of section. The frame was made to take all the connecting parts of the engine, except the furnace pads and the equalizer fulcrums, the equalizing rigging being kept in all respects as before. The I-beam with flanges at top and bottom, being the ideal cross-section for beam strength, has occasionally been departed from owing

In hot-blast heating the proportional heating surface is generally expressed in the number of net cubic feet in the building for each lineal foot of 1-in. steam pipe in the heater. On this basis, in factory practice, with all of the air taken from out of doors, there is generally allowed from 100 to 150 cub. ft. of space per foot of pipe, according as exhaust or live steam is used, the term "live steam" being taken in its ordinary sense as indicating steam of about 80 lbs. pressure. If practically all of the air is returned from the building, these figures will be raised to about 140 as the minimum, and possibly 200 cub. ft. as the maximum, per foot of pipe. Of course the larger



Cast-Steel Locomotive Frame.



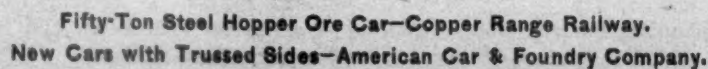
Wrought-Iron Locomotive Frame.

to considerations of side-stiffness of the frame wearing surfaces and bearing surfaces. A few of the comparative strengths of the old and new frames are noted in the drawing. In this design the channel sections were made to open in the same direction and the flanges were made to cast downward in order to delay the cooling, the purpose being to reduce the tendency to warp. It is thought by the designer that larger sink heads than are usually employed should be provided in such work.

This design was prepared by Mr. Van Ness De Lamater, a student in mechanical engineering in Sibley College of Cornell University. He presents it for criticism, and the opinions of readers will be acceptable. It is not above criticism, but this is believed to be the first instance of a design for a cast-steel frame in which the form has been specially arranged with reference to the peculiarities of the material. For the purpose of comparison a drawing of the wrought-iron frame forming the basis of this suggestion is included.

This new design was prepared under the direction of Prof. H. Wade Hibbard.

the building in cubic contents, the less its wall and roof exposure per foot of cubic space, and consequently the less the loss of heat, and the smaller the heater relatively to the cubic contents. In such buildings, used for manufacturing purposes, where the occupants are usually well scattered, an air change once in fifteen to twenty minutes represents the general practice; but in public and similar buildings this change is of necessity reduced to one in seven to twelve minutes. Owing to the increased loss of heat by leakage or ventilation under such conditions, and also to the demand for a slightly higher temperature than in the shop, the allowance is dropped to from 70 or 75 to 225 cub. ft. of space per foot of pipe, for all of the air is taken from out of doors, and low-pressure steam is usually employed. The great range in all of these figures must make evident the influence of the size, construction and uses of a building upon the size of the apparatus required, and show the necessity of extended experience for the proper designing of any system of heating and ventilation.—Extract from "Treatise on Ventilation and Heating," by B. F. Sturtevant Company, Boston, Mass.



COAL AND ORE CARS.

The American Car and Foundry Company.

In the matter of distributing the loads among the members, steel car construction has usually followed the practice with wooden cars, the entire load being provided for in the underframe, the body or box being used merely to confine the load. The two coal car designs by Mr. C. A. Seley, of the Norfolk & Western Railway, illustrated in this journal in April, 1900, page 100, and February, 1901, page 42 were exceptions in that the sides were trussed to aid in carrying the load, and the success of these cars indicates the practice to be good. We are now enabled to describe two new designs by the American Car and Foundry Company, prepared under the direction of Mr. Geo. I. King, Manager of the Steel Car Department, which are built on this plan. One is an 80,000-lb. coal car which was designed for use on a large Western road, and the other a 100,000-lb. ore car for the Copper Range Railway. Both cars use structural shapes exclusively and both employ trussed side frames and built-up plate body bolsters, but the details of the underframes are very different. The cars are not heavy but there is no appearance of sacrifice of strength for the sake of lightness.

FORTY-TON COMPOSITE COAL CAR.

Designed for a Western Railway.

In this design the hopper sides and floors are of wood and the rest of the construction of steel. There are two 15-in. channel center sills, continuous from end to end, and two 9-in. channel side sills with trussed side frames of the Warren type of girder. In the drawings the sizes and sections of the various members are indicated. In a dotted line the height of a load of 88,000 lbs. of ore, at 150 lbs. per cubic foot is shown. The following table summarizes the general dimensions:

FORTY-TON COMPOSITE COAL CAR.

General Dimensions.

Length over end sills.....	30 ft. 1/2 in.
Length inside.....	29 ft. 0 in.
Height of top of side.....	10 ft. 0 ins.
Height to top of 30-degree load.....	12 ft. 7 ins.
Height to top of sills.....	3 ft. 10 1/2 ins.
Width over all.....	9 ft. 11 1/2 ins.
Width inside.....	9 ft. 0 ins.
Cubic capacity to top of sides.....	1,400 cu. ft.
Cubic capacity of 30-degree load.....	1,704 cu. ft.
Cubic capacity 30-degree load of coal at 52 lbs. per cu. ft.....	88,600 lbs.
Standard load limit.....	88,000 lbs.
Estimated weight.....	34,000 lbs.
Journals.....	5 by 9 ins.
Total area of door openings.....	35.5 sq. ft.

In the calculations the following figures were used:

Base dead load.....	28,000 lbs.
Maximum live load.....	96,000 lbs.
Weight of trucks.....	13,400 lbs.
Deduct weight of wheels and axles.....	7,900 lbs.
Weight of truck above axles.....	5,500 lbs.
Gross body dead load.....	28,000 - 5,500 = 22,500 lbs.
Deduct for bolsters, etc.....	2,000 lbs.
Net body dead load.....	20,500 lbs.
Assumed live load.....	96,000 lbs.
Total static body load.....	96,000 + 20,500 = 116,500 lbs.
Add 50 per cent.....	58,250 lbs.
Final total load for calculation.....	174,750 lbs.
Load per cubic foot for calculation.....	103 lbs.

FIFTY-TON STEEL, HOPPER ORE CAR.

Copper Range Railway.

This car is built of steel throughout and is a novel arrangement for this service. The sides constitute a truss with 5 and 8-in. channels in the form of the letter M, with 3 1/2 by 3 by 5/8-in. top angles. Eight-inch channels are used for side sills and the center sills are not continuous between the bolsters. From the bolsters to the ends of the car are two 15-in. channels, between which the draft gear is placed. The whole structure gives the impression of being constructed from the standpoint of a bridge or structural engineer, who has a high regard for the holding capacity of rivets. Between the bolsters a floor system of angles is provided and the corners of the car are braced by angles. It is evident that the side girders

are depended upon to carry the main portions of the load and that the stresses of pulling and buffing will be received by the bolsters, end sills and side sills. The heavy construction of the bolsters is apparent in the drawings. It will be noted that the side sheets of this car do not extend down to the side sills.

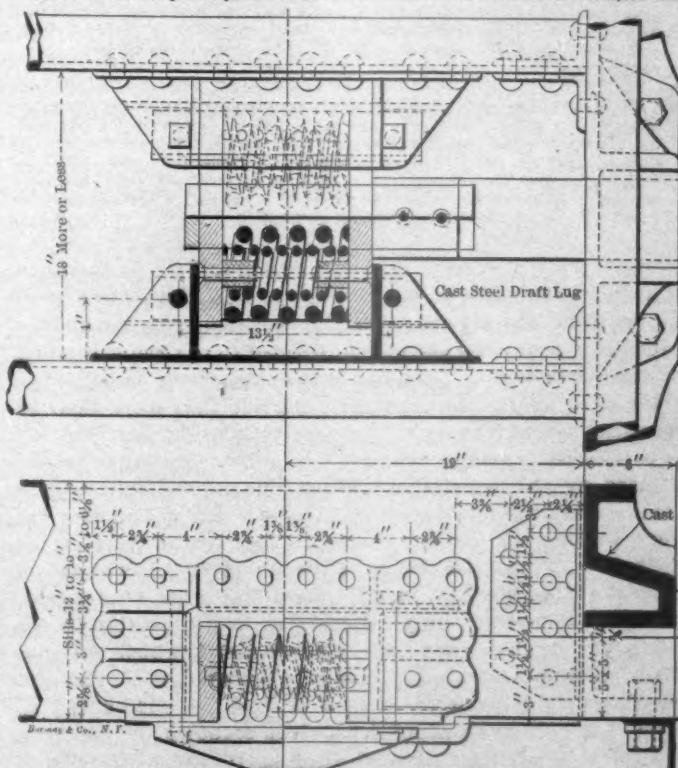
Fifty-Ton Hopper Ore Car.

General Dimensions.

Length over end sills.....	25 ft. 3/4 in.
Length inside.....	24 ft. 0 in.
Height to top of sides.....	9 ft. 6 ins.
Height to top of 30-degree load.....	11 ft. 11 1/2 ins.
Height to top of sills.....	3 ft. 3/4 in.
Width over all.....	9 ft. 1/4 in.
Width inside.....	8 ft. 6 ins.
Cubic capacity to top of sides.....	907 cu. ft.
Cubic capacity to top of 30-degree load.....	1,127 cu. ft.
Maximum capacity, iron ore at 150 lbs.....	169,050 lbs.
Maximum capacity copper ore at 100 lbs.....	112,700 lbs.
Maximum capacity limestone at 85 lbs.....	95,795 lbs.
Maximum capacity coal at 52 lbs.....	58,604 lbs.
Standard load limit.....	110,000 lbs.
Estimated weight.....	30,500 lbs.
Journals.....	5 1/2 by 10 ins.

It is evident that the stresses have been carefully considered for the record of the design in this respect is included in the drawings. The assumed load is as follows:

Base dead load.....	32,000 lbs.
Maximum live load.....	120,000 lbs.
Weight of trucks.....	14,400 lbs.
Deduct weight of wheels and axles.....	8,400 lbs.
Weight of trucks except wheels and axles.....	6,000 lbs.
Gross body dead load.....	32,000 - 6,000 = 26,000 lbs.
Deduct for bolsters, etc.....	2,000 lbs.
Net body dead load.....	24,000 lbs.
Assumed live load.....	120,000 lbs.
Total static body load.....	= 120,000 + 24,000 = 144,000 lbs.
Add 50 per cent, or.....	72,000 lbs.
Final total for calculation.....	216,000 lbs.
Load per cubic foot for calculation.....	191 lbs.
Static load at end of bolster, plus 100 per cent.....	65,200 lbs.
Flange stress.....	182,500 lbs.
Stress allowed per square inch.....	15,000 lbs.



Twin Spring Standard Draft Gear.

Draft Gear.

For use in the construction steel cars of 30, 40 and 50 tons capacity these builders have designed a standard draft gear. This is a twin spring gear with cast steel draft lugs riveted to the webs of the center sills and adapted to a space of about 18 ins. between the webs, and to sills from 12 to 15 ins. high. The coal car illustrated in this connection was arranged with a view of using the Dayton Malleable Iron Company's draft rigging. The drawing of the standard draft gear illustrates the cross section of the cast steel end sill used by these builders; this, however, was not employed in either of the designs illustrated here.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—Nothing will be inserted in this journal for pay, EXCEPT IN THE ADVERTISING PAGES. The reading pages will contain only such matter as we consider of interest to our readers.

Contributions.—Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.

To Subscribers.—The AMERICAN ENGINEER AND RAILROAD JOURNAL is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied. When a subscriber changes his address he ought to notify this office at once, so that the paper may be sent to the proper destination.

The Standard Freight Car was advanced by the American Railway Association at the meeting in New York April 24 to a positively hopeful and promising position. Acting upon a committee report the association decided to ask the executives to take the necessary steps to change the traffic association's rules as to minimums in order to provide that there shall be no pecuniary advantage to any interest arising from the use of cars larger or smaller than the unit or standard car as recommended by the association. When this is accomplished the standard car will undoubtedly be adopted. This committee has done yeoman service and its report goes to the roots of the difficulties in a concise review of the movement. It was shown that of all the box cars in the United States but 4.1 per cent. are more than 36 ft. long. Cars 34 ft. long constitute 50 per cent. of the whole, and this compels action which will not place so large a number of cars at a disadvantage. The proposed standard car is 36 ft. long, 8 ft. 6 ins. wide and 7 ft. 6 ins. high, all inside dimensions. It is proposed that this car, with a cross-sectional area of 63.75 sq. ft. and a capacity of 2,295 cu. ft. shall be the unit of classification minimums. In order to provide for the 34 ft. cars, it is proposed that a minimum be established for their use which shall employ their capacity on the basis of a length of 34 ft.; width, 8 ft. 6 ins.; height, 7 ft. 6 ins. Cars more than 36 ft. and less than 34 ft. will be placed at a disadvantage and relatively uneconomical to the shipper. Appreciating the importance of the subject the association wisely urged the treatment of the minimums co-operatively by the various associations in such a way as to permit of taking advantage of modifications and changes which may be suggested during a period of six months. There is good reason to hope that the concluding arrangements for the standard box car may be made at the October meeting of this association.

Considerable trouble has been experienced from the use of steel castings, but there is, nevertheless, an increasing demand for them to replace those of iron, wherever an increase in strength is desired without increasing weight. No better example of this can be given than in the present problem of the design of a locomotive. The failures that have been experienced with steel castings have come chiefly from large and comparatively thin castings, as in the case of the frames of a locomotive. Many castings are sometimes made of long and poorly designed frames, in order to get a few good ones; this is due to the comparatively large shrinkage and to the absence of any movement of the castings in the sand. The molds are packed very hard for such work, and this causes the metal to pull away from the weakest point before it is cooled sufficiently to have much strength. Even frames made in two parts are not always reliable on account of the frequent occurrence of honeycomb; but with the proper care in making the mold so that the gases may pass off, and in pouring the metal from a proper height to give a pressing action as it enters the mold, this trouble is considerably decreased. A matter of most importance to the successful steel casting is in the design, avoiding altogether the bringing of a large mass of metal next to a thin part. The design should be prepared with reference to the peculiarities of the metal as well as for the work it is intended to do. By keeping a uniform section throughout the design, no trouble is experienced in the separation of the thin parts from those of greater section. Also with better foundry practice there seems to be no reason why much of the time and expense of machining can not be saved by turning out good steel castings. One of the prominent iron and steel companies manufactures shells for the Government that are cored out close enough to stand the rigid Government inspection and tests, which requires a casting that is almost perfect. The only finish put on the inside of these shells is a little grinding; the outside, of course, being turned and finished. On the recent class "J" passenger locomotive of the Lake Shore & Michigan Southern Railway about 28,000 lbs. of cast steel were used in the details of the engine, including the equalizers, foot plates and a number of parts usually made in forgings. While much has been done to develop cast steel in the last few years, there is reason to expect still more in the future from better foundry practice, and the use of steel castings will increase until the use of cast iron and forged wrought iron will be exceptional. In the matter of design we present in this issue a drawing of a locomotive frame suggesting forms for the cross sections upon which we shall be glad to have criticisms from our readers.

THE M. C. B. ASSOCIATION AND STEEL CAR DESIGN.

In the matter of steel car design the Master Car Builders' Association has thus far been little more than an interested spectator. The subject has several times come before the association in the way of committee reports, but of definite action in the form of suggestion and guidance there has been none. Up to the present time the development of steel cars has been in the hands of a few railroad men and the car builders. Perhaps this is well because of the rapid development which results from individual efforts of this kind, unhampered by limitations except those imposed by commercial conditions. Certainly the progress has been great and the results satisfactory, but it cannot be possible that there is no way in which the association can help at this stage even if it could not before. There are certain principles in car design which the association might state clearly as representing the opinions of those who maintain and operate the cars and these would probably exert a wholesome influence upon the designers and ought to prove beneficial. For example, it would be well for the association to go on record definitely with reference to the matter of supporting the entire loads upon the center plates. It would be well to know the opinion of the association with regard to the desirability of placing a portion of the load upon the side bearings. In the

matter of underframes definite action with reference to the arrangement of the sills with regard to the disposition of draft gear stresses would be very valuable just now. If it is necessary to supply a continuous draft gear by means of continuous center sills it would be wise to state the need plainly and if an arrangement of sills and bolsters whereby these stresses may be transmitted through riveted connections is admissible in cars of large capacity this should be recorded. Almost all the designs of steel cars have been arranged with a view of dispensing with truss rods, but it is by no means certain that this is the most desirable course. Another question as yet unsettled is whether or not the floor system should always be made strong enough to support the entire load independently of other parts. Should all cars be built like flat cars with a floor system sufficient for the load upon which to build gondola, hopper or box car structures, or should the sides of these cars be made in the form of trusses with a view of partaking in the duty of carrying the load? Good work may be done in a discussion of this question because it will have a vital influence on the future of car construction. In fact, all of these questions are important and there can be no doubt that the opinions of the master car builders would be the means of saving many steps in the progress of the steel car. It will doubtless be necessary to express the opinions tentatively because of the uncertainties of the paths of development, but as a guide to the workers in this field the association should at least discuss some of these questions. Unless we mistake the feelings of several prominent members some such suggestion as this will come before the next convention.

MOMENTUM THEORY OF BOILER EXPLOSIONS.

The statement is often made that if boilers are sufficiently strong they will not explode. It is generally believed, and is probably true, that boiler explosions result from weakness, but it is not safe to say that the strongest boiler possible to be made will not under certain conditions explode.

It is not long since these disasters were always mysterious, and even now one cannot say that all the mysteries have been explained. For example, why should the bursting of one boiler of a battery sometimes cause all or nearly all in the battery to explode, as sometimes occurs. This is not understood, and because of the difficulties of experimental study along this line it may never be understood. A very pertinent suggestion was recently offered editorially in "The Engineer," concerning the momentum of explosion of heated water in which an enormous amount of energy is stored. In a closed vessel the explosive energy of highly heated water is held in check by the pressure resulting from the confinement of the boiler. The argument is this: Given a tube held on end, one half filled with water at a temperature of 358 degs. F., the other half being filled with steam of the same temperature and with a total pressure of 150 lbs. Let a jet of cold water be injected into the steam space. It will condense the steam instantly and beyond question the moment the pressure is annihilated a portion of the hot water will explode into steam.

"The received idea is that there would be an instantaneous rise of pressure which would effectively prevent the further conversion of water into steam. In a word, the explosion would be stopped half-way. Is this a certainty? We venture to think that it is not; and to us it is quite conceivable that the momentum—if we may use the word—of the conversion of heat energy into mechanical energy would suffice to continue the operation, with the result that the cylindrical vessel would be burst. This result has, indeed, been obtained in another way by direct experiment. There are experiments tending in the same direction on record with a similar ending, but unfortunately, for some reason not known, the experiment may fail fifty times and then succeed. There is very good reason to believe that there is much more than appears at first sight in the theory of momentum of explosion."

If it is a fact that heated water once vigorously started

in the conversion of its heat energy into mechanical work will continue in its course until something gives way, we have an explanation of many hitherto mysterious explosions, and the theory appears to be reasonable.

PRACTICAL ALTRUISM IN THE SHOP.

During the past few years there have been so many prominent examples of successful business enterprises which have been obviously benefited by systematic efforts to improve the relations between the employer and the employed that the movement cannot fail to have been noticed by everyone, but probably few realize its general character and wide scope. There seems to be a marked reaction from previous conditions in this respect which is fast assuming noteworthy proportions. Efforts to render employment attractive and surround workmen with an atmosphere which speaks of a regard for the personal comfort and conveniences of men are being put forth in a businesslike way in various parts of the world, and the tendency is toward a feeling of greater responsibility over the lives of those who work with their hands. It is not believed that the motives are always entirely disinterested, but whatever the motive, any observer may see in different directions a desire to build comfortable, healthful, cheerful and well-lighted shops, and put a little moral responsibility into the relations between men.

There has been a good deal of this for years in such organizations as Krupp's in Germany, in various other large foreign industries and on the French railways; the idea is not new, but it is now taking a prominent place in the policies of many enterprises. We make no comment upon the methods, comparisons of details or criticisms of various effects produced by different plans, but it is to the general principle that better work is done by comfortable, contented workmen that we wish to draw attention. Never before has such attention been given to the heating, lighting and ventilation of shops and the arrangement and equipment of toilet conveniences, and in large railroad shops these factors are now so prominent that the matter calls for examination and comment. A workman in a shop where absolutely nothing is done for his comfort does not fail to become impressed with the fact that he is there for what may be got out of him and it must have its effect upon his work. As he is supposed to be a reasonable being it is fair to expect that he will respond equally to that which will put a little of something besides the mere money-paid-for-work-done idea into the relations between the parties concerned.

Some of the examples noted here may be considered unusual and extreme cases, and, perhaps, some may have been criticised already, yet they all stand for an established principle. The Browne and Sharpe, of Providence; Sherwin-Williams Co., Cleveland Hardware Co., Cleveland Twist Drill Co.; the T. B. Laycock Manufacturing Co., of Indianapolis; Acme White Lead Co., of Detroit; Gorham Manufacturing Co., Joliet Steel Works, Cleveland Cliffs Iron Co., Ishpeming, Mich.; the Draper Co., of Hopedale, Mass.; the National Cash Register Co., of Dayton, O.; the Acme Sucker Rod Co., of Toledo, and the Crane Co., of Chicago, are examples of the principle worked out in different ways, and the testimony is universally favorable to the idea. In these establishments it appears to be the rule that the grade of workmen is improving, and in some there are even "waiting lists" for ordinary unskilled labor. There must necessarily also be a corresponding improvement in the product, quality as well as quantity. The plans at most of these establishments include methods of supplying noonday lunches, well cooked and attractively served at nearly exact cost, the company furnishing the equipment and dining room, paying the cooks and providing time for the necessary number of waiters from the shop force.

It is easy to go too far and overdo an idea of this kind and no doubt this will be done, perhaps it has already been done in some cases, but this will be the exception which proves the rule, and a movement which is so sensible, profitable and right

must continue. In railroad service it has taken the form of Y. M. C. A. privileges, reading rooms, club rooms, hospital facilities, pension systems and improved conditions of the shops themselves and their surroundings. Of the efficiency and value of the railroad Y. M. C. A. the late Cornelius Vanderbilt said:

"I have for many years felt the deepest interest in this work and believe that its importance can hardly be overestimated, both to the men and the companies in whose service they are. It educates and spiritualizes; it promotes economy and thrift; it brings railroad men together with surroundings and discussions which produce the happiest results to themselves, their families and their employers."

Recent plans for new railroad shops which have come before us always indicate an increasing tendency in this direction. One of them, in addition to a good locker house with an individual clothes locker for every man in the plant and good toilet rooms, provides for a club house exclusively for the employees, to be built in order to provide a suitable place for the men to spend their noon hours and other leisure moments. In another case, where the shops are in the midst of a "shop town," the railroad company has interested itself in the village itself, in the equipment of water works, the laying out of streets, the planting of trees and many other things which will tend to attract men there and create the desire to own their homes, to become permanent. This shop has been troubled with floating men, men without families who were not content to stay anywhere more than a short time. It may become entirely different when the town is made attractive as a place to own a home.

Each case has its own peculiar conditions. Probably little that is applicable in one place may be copied from another, but there is every reason to believe that the comfortable shop and sensible way of dealing with shop employees on a strictly practical and intelligent basis will promote the best interests of the employer and earn the largest returns. It is good business policy.

CORRESPONDENCE.

RATIOS OF TOTAL WEIGHT TO HEATING SURFACE.

To the Editor of the American Engineer:

The article on page 89 of your March, 1901, issue contains considerable food for reflection. In the first place, while the relation of heating surface to weight is undoubtedly an important one, yet I am not sure but that a more valuable comparison for guidance in design, exists in the relation between heating surface and horse-power. The former comparison unless due weight were given to other factors, might at times prove misleading. What is required is a certain amount of tractive power and a boiler capable of maintaining it at the desired speed and with the desired train weight. After sufficient weight has been obtained for the desired co-efficient of adhesion, a good designer will cut off every pound of superfluous weight possible in connection with proper strength and life of the remaining machinery.

Referring to the table contained in the article in question, to show how this comparison may be misleading, it is probable that the compounding of the Lehigh Valley Engine No. 681 added about 10,000 lbs. to the total weight, over the weight of a simple engine of equivalent cylinder power. If we compare it with other simple engines as regards the ratio of total weight to heating surface, we should deduct the weight due to com-

pounding from total weight, so that the ratio becomes

As the heating surface of a compound engine is probably about 20 per cent. more effective, due to use of a less quantity of steam and better distribution, than the heating surface of a similar simple engine, it would probably be more accurate to increase the heating surface by 20 per cent. before obtaining the ratio; this would give

45.7 for the Lehigh Valley engine No. 681, and for the Baltimore & Ohio engine No. 1,450,

It would appear from this that a comparison of ratios between total weight and heating surface is not always a true index of the merit or demerit of the design of an engine, if no account is taken of other factors which may have a very important bearing on the case.

Another train of thought started by this article was the relation between tube heating surface and firebox heating surface. I enclose a table in which is given the ratios for the engines shown in the table on page 90 of the same issue, and for an additional Atlantic type, and 10-wheel engine. The table also contains the ratios between tractive power and total heating surface, the actual heating surface in compounds being increased by 20 per cent.

Road.	Engine number.	Flue heat. sur- face.	Firebox heating surface.	Total heat. sur- face.	Total heat. sur- face corrected for comp'd g.	Ratio F. H. sur. F. H. sur.	Tractive power.	Ratio Tractive power, total H. sur.
N. Y. C. & H.....	2,980	3,298	180	3,478	.....	18.32	24,674	7.06
L. S. & M. S.....	650	3,163	174	3,337	.....	18.21	25,000	7.61
C. & N. W.....	1,015	2,817	199	3,016	.....	14.15	22,100	7.33
L. V.....	681	3,890	215	4,105	4,926	18.19	48,400	9.83
B. & O.....	1,450	2,513	150	2,663	3,196	16.75	22,000	6.84
B. C. R. & N.....	77	2,396	156	2,552	.....	15.36	23,400	9.17
P. R. R.....	820	2,102	218	2,320	.....	9.643	21,500	6.66
L. V.....	673	2,631	167	2,798	.....	15.75	22,100	7.88
L. V.....	801	2,538	172	2,706	3,250	14.74	28,200	8.67

*Heating surface, water bars omitted.

**Figures given in original do not agree with previous description.

†Atlantic Type; principal dimensions same as C. & N. W. engine

No. 1015; total weight, 157,000.

‡See Railroad Gazette, December 28, 1900.

A large ratio would seem to indicate a small firebox in comparison to the tube length, while a low ratio would indicate a large firebox in comparison with the length of flue. It would be exceedingly interesting to know what the effect of varying the flue length and size of firebox would be on combustion and evaporation, and what would be the proper proportions between size of firebox and length of flue. This proportion with fireboxes of the same general type would be indicated by the ratio between the two heating surfaces. In a general way, it would seem that a very large box with short flues, while permitting of very thorough combustion, might have a heat loss through insufficient tube surface to absorb all the heat. On the other hand, with the other extreme, on account of the small cubic capacity of firebox and rate of combustion, there might be a loss due to the lack of space for air to mix in the proper proportions with the volatile matter of the fuel before the gases have cooled below the ignition point, or escaped from the stack. As the wider the type of firebox, the greater the weight per lineal foot of the firebox; and as the longer the flues, the greater the total heating surface; then the higher the ratio between flue heating surface and firebox heating surface, the less will be the weight of the engine per foot of heating surface, and the lower the ratio of tractive power to heating surface. This seems to be another reason why the judging of a design by the weight per square foot of heating surface, without taking into account modifying factors, would be misleading.

If the foregoing has any value, by referring to the table it would seem that the Baltimore & Ohio engine, with about an average ratio between tube and firebox heating surfaces, only has to furnish 6.884 lbs. of tractive power for each square foot of heating surface. The tractive power given is, of course, the maximum at slow speed. As the most economical point of cut-off (which should be the working point) is a certain percentage of the stroke (somewhere near 25 per cent.), the working tractive power is directly proportional to the maximum; so that the maximum tractive power can be used to a certain extent for purposes of comparison.

This basis of comparison, like the formulas determined by the Master Mechanics' Association, contains only one factor, the working force. This factor alone, without considering speed, with which the problem is so intimately connected, is of very little real value for accurately determining the correct proportions of a boiler. If, however, we combine the working force with the speed or rate of working, we then have the power. As the boiler must furnish a certain amount of power, or an amount of energy sufficient to perform a certain amount of work in a given time, it becomes apparent at once that the real basis from which the amount of heating surface should

be computed is the maximum power, and that the total heating surface of any boiler is the product of a constant, times the maximum power demanded by the service. If we take for the unit of power, a horse-power, the formula for heating surface becomes of the following form:

Total heating surface = constant \times maximum horse-power.
The maximum horse-power is easily found from the formula:

$$\text{Maximum horse-power} = \frac{\text{maximum speed} \times \text{tractive power}}{375}$$

The maximum speed being in miles per hour, and the tractive power being the working force necessary at the given speed, with given weight of train, and in connection with the profile of the road on which the engine is to be used. There are many well-tried formulas for the calculation of necessary tractive power under any conditions. The resistance per ton weight (of 2,000 lbs.) of train and engine for a grade is, of course, $R = .3788$ lbs. per foot rise per mile. The Baldwin formula for resistance due to speed is accurate and simple: $R = 3 + \frac{V}{6}$, $V =$ speed in miles per hour.

Their allowance for average curvature is the resistance due to 1.5 ft. grade per mile per degree. The sum of all resistances, times the total weight, is the total resistance which must equal the tractive power.

Of course these ratios and constants for comparison only hold good for the same general type of firebox, and a grate surface of sufficient area for the proper combustion of the class of fuel used. All of the engines in the table have a width of firebox greater than the over-all width of frames. It would be of little value to compare them in this manner with an engine having a deep narrow firebox; where, a low ratio of firebox heating surface to tube heating surface, a low ratio of tractive power to total heating surface, and a low weight of engine per square foot of heating surface, is obtainable. The best ratio of firebox heating surface to tube heating surface will probably be found to vary with the class and quality of fuel. A poor fuel, or a slow-burning fuel, such as anthracite coal, requires a larger grate surface than a free-burning bituminous coal. A large grate means a large firebox, with a proportionate reduction in total heating surface.

For purposes of comparison, and for a check in design, we need to have established the following ratios:

1. Ratio of flue heating surface to firebox heating surface.
2. Ratio of total heating surface to maximum horse-power.

Each of these ratios should be determined separately for the following conditions:

1. Wide firebox—slow burning bituminous, with high percentage of fixed carbon.
2. Wide firebox—rapid burning bituminous, with high percentage of volatile matter.
3. Narrow firebox—same fuel as in No. 1.
4. " " " " " " No. 2.
5. Wide " —anthracite.
6. Narrow " — " "
7. Wide " —fine anthracite and bituminous.
8. Narrow " — " " " "

The proper allowance of the heating surface for compounds in per cent. that should be added to the actual heating surface for purposes of comparison, should be determined for use in connection with the above ratios. This work falls most properly in the sphere of the Master Mechanics' Association, and it is suggested that it be made a subject for the 1902 meeting.

The weight of engine per square foot of heating surface, for the same types and conditions, would then be an interesting and valuable quantity—to be kept as low as strength and durability will permit.

E. F. GAINES,
Mechanical Engineer,
Lehigh Valley Railroad.

The Crane Company, of Chicago, manufacturers of valves, fittings, etc., in order to increase their office facilities, will erect a modern fire-proof office building, five stories high and basement. The building will be 90 by 100 ft., and located in the vicinity of its large cast iron, malleable fittings and valve works, at Canal and 12th streets.

FOUR NEW TRAINS FOR THE "LAKE SHORE LIMITED."

The latest art in car building is to be seen in the four very elegant new trains built by the Pullman Company for the Lake Shore Limited and placed in service April 3. No effort or expense have been spared to place all of the modern comforts and conveniences at the command of the traveling public. A particularly noticeable feature in the furnishings of the cars is the absence of all heavy carvings, ornate grilles and metal work, stuffy hangings, etc.; the simplicity and quiet elegance of design, combined with the beauty of the natural wood, being relied upon entirely for decorative effect.

The trains are lighted throughout by electricity furnished from an engine and dynamo in the baggage car. The smoking and observation rooms have side reading lamps placed in a convenient location; also each section of the sleeping cars is provided with a reading lamp. Over the tables in the dining cars are side lamps and in all cars are center lamps with four 16-c.p. incandescent lights. These trains are made up of a baggage car, buffet library smoking car, dining car, three drawing-room and state-room sleeping cars and an observation compartment car. The buffet library smoking car contains a spacious smoking room, seating thirty persons, equipped with easy chairs, a library equipped with standard literature and all of the best class of periodicals, a completely appointed barber shop and bath-room, a writing desk with suitable stationery, and a buffet from which light refreshments are served. The dining car has five double tables seating four persons each and five single tables seating two each. These cars are very attractive, being finished in choice Santiago mahogany. The sleeping cars contain twelve sections and a drawing-room and a state-room, the rooms are connected by folding doors, so that they may be used separately or en suite. Ample toilet facilities are provided for both men and women. These cars are finished in vermilion wood and marquetry. The observation car has eight compartments, finished in mahogany, Circassian walnut, satinwood and prima vera. The large observation room is finished in vermilion wood and equipped with comfortable chairs, sofas and a writing desk. The services of an expert stenographer can also be procured on this car, free of charge. A large observation platform affords an exceptional opportunity to view the passing scenery.

These trains make daily trips eastbound from Chicago and Cleveland to New York and Boston via the Lake Shore & Michigan Southern, New York Central and the Boston & Albany Railways; and westbound from New York to Cleveland, Chicago and St. Louis via New York Central, Lake Shore and Big Four Railways.

"The Duties of a General Manager" was the subject of a very interesting and instructive address by Mr. L. E. Johnson, General Manager of the Norfolk & Western Railway, before the engineering students of Purdue University, April 8th. After describing briefly the organization of a railway, the character of the business which reaches the office of the general manager was discussed in detail. Some amusement was caused by incidents arising in connection with claims, and by exposing the record of a single day's work. Mr. Johnson convinced his student audience that the office of a general manager was not a sinecure. During the week ending April 20th Mr. William Kent, of New York, delivered a lecture each day before the seniors in Mechanical, Civil and Electrical Engineering. The subjects were of his own choosing, as follows: Monday, "Steam Boiler Economy"; Tuesday, "The Iron and Steel Industry"; Wednesday, "The Organization of a Manufacturing Establishment"; Thursday, "Some Engineering Problems"; Friday, "Some Elements of a Successful Engineering Career." On Wednesday afternoon he delivered a more formal address before juniors and seniors of the three schools of engineering, upon the subject of "Engineering and Economic Science."

STEEL CARS BY THE AMERICAN STEEL FOUNDRY COMPANY.

A number of types of steel cars have been designed by the American Steel Foundry Company of St. Louis, and arrangements have been made at the works at Granite City to build them in competition with other builders. The three engravings presented here illustrate the exterior appearance of a

having cast steel truck bolsters and special channel shaped arch bars.

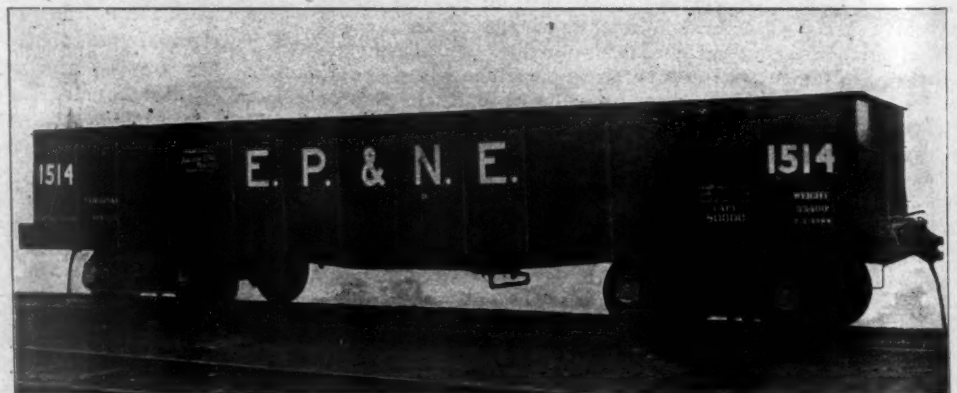
The gondola car has substantial center sills of plates and angles, the depth at the center being 22 in., tapering at both ends. This construction permits of securing the desired depth of the sills at the center without interfering with the truck, while the draft gear is placed between the center sills. The floor plates are laid on Z-bars placed between the center sills and side plates. At the side the floor plates have additional support from angles riveted to the floor and side plates. These angles tend to stiffen the sides and to form a plate girder at the lower edge of the side plates to take the place of side sills. The bolsters are built up and riveted to the center sills which are not cut. Angles in the form of stakes are riveted to the side plates as stiffeners. These cars have four drop doors and small side doors through the side plates at each end. The gondola cars of 40 tons capacity weigh 31,000 lbs. empty.

Hopper cars without continuous center sills are novel. These cars for the Chicago & Alton are built in this way, the hopper being entirely free from obstructions inside



110,000-Pound Capacity Hopper Car—Chicago & Alton Railway.

hopper car of 110,000 lbs. capacity for the Chicago & Alton, a drop bottom gondola of 80,000 lbs. for the El Paso & Northeastern and also a test weight car for the Chicago & Alton. The Delaware & Hudson has also received a number of 80,000-lb. cars exactly similar to this drop bottom gondola. Detailed descriptions of the under-frames and structural features are not available at this time. Standard rolled steel shapes and plates are used throughout, the cars, except the scale weight car, being mounted on steel trucks as made by these builders,



80,000-Pound Drop Bottom Gondola—El Paso & Northeastern Railway.



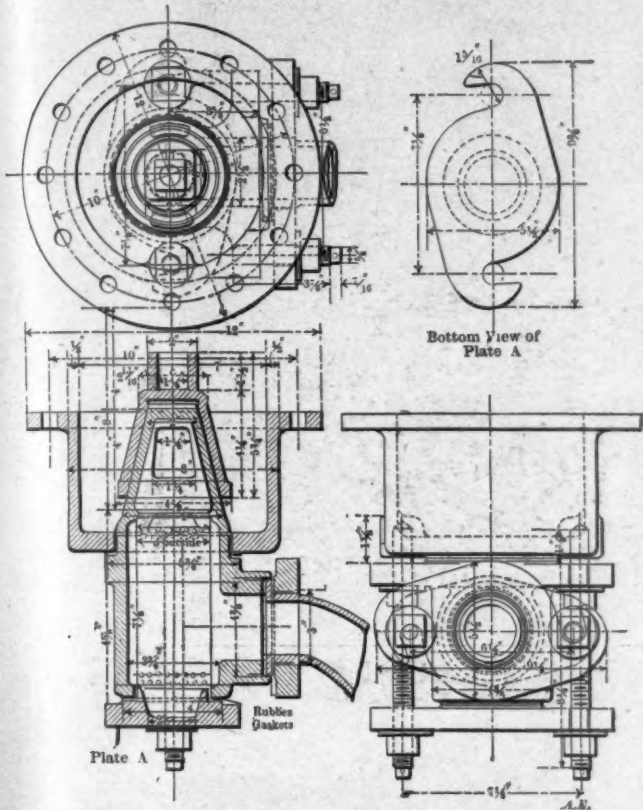
Test Weight Car—Chicago & Alton Railway.

and the load is carried at the sides by a plate girder 30 ins. deep, with angles at the top and bottom. These girders extend the whole length of the car. The side plates of the hoppers are riveted to these girders, forming a strong arrangement. Side stakes of angles extend from the top of the sides to the bottom of the plate girder, passing the upper girder angles by offset bends. At the center of the car substantial stiffening is secured by a partition or bulkhead across from side to side, dividing the interior of the hopper in the center. The end structure is substantially braced and the draft gear is placed between short center sills which do not pass through the hopper ends. No special effort was made to secure light weight, these cars weighing, empty, 41,200 lbs.

Mr. A. J. Hitt, General Superintendent of the Chicago, Rock Island & Pacific, has been appointed General Manager, with headquarters at Chicago, effective May 1, 1901.

TANK WELL AND STRAINER.

In looking over the tenders of the new passenger engines built by the Brooks Locomotive Works for the Lake Shore & Michigan Southern Railway this tank valve and strainer was noticed, and while it is not new, its good features warrant its presentation here. This design was developed by Mr. John Player on the West Shore road a number of years ago. It combines a settling basin for mud, a tapered valve which will not lock, a large cylindrical strainer and a casing with an eas-



Tank Well and Strainer.

ily removable plate at the bottom. This plate may be taken off without even removing a nut. The nuts are slackened and the plate turned slightly, when the plate and strainer will come down for cleaning. The strainer has a large area, and in practice does not seem to choke the passage of the water. This design has been used extensively by the Brooks Locomotive Works.

The Celtic, launched last month, has, says "Engineering," the distinction of being the largest ship in point of tonnage that has yet been built; although in point of speed she is excelled. The Celtic represents a distinctly interesting type, which promises a large financial reward; for, with her speed of from 16 to 16½ knots, her coal bill will be very much less than that of many of her competitors on the Atlantic, while, at the same time, she is certainly not deficient in any of the comforts provided on the faster ships. In order to attain the high speed, it has been found practically impossible to carry any cargo, whereas in the Celtic something like 13,000 tons of cargo may be carried, which, while adding to the revenue, almost of necessity means a steadier, and therefore a more comfortable, sea ship for passengers. The question, however, has its other side, and there can be no doubt that for advertising purposes the fast ship is a valuable acquisition, and provided, as is pretty certain, she secures the best of the traffic, the financial results need not be unsatisfactory. This view, we know, is not universally accepted, but the North German Lloyd are probably acting on an experience which was highly satisfactory, when they ordered a vessel to equal in speed their Kaiser Wilhelm der Grosse, and another to excel in speed even the 23.36 knots of the Deutschland.

PERSONALS.

Mr. George S. Morison, Civil Engineer, New York, has changed his address to 49 Wall Street, Room 1713 Atlantic Building.

Mr. G. W. Wildin, Mechanical Engineer of the Plant System at Savannah, Ga., has been appointed to a similar position with the Central Railroad of New Jersey, with headquarters at Jersey City, N. J.

Mr. F. W. Cox, General Machinery Inspector of the Baltimore & Ohio, has resigned to accept the position of Superintendent of the Milwaukee Electric Company, with office at 296 Reed street, Milwaukee, Wis.

N. O. Whitney, Professor of Railway Engineering at the University of Wisconsin, and formerly assistant engineer of the Pennsylvania Railroad, died at Madison, Wis., March 18, at the age of 42 years.

Mr. George F. Baer, President of the Philadelphia & Reading, was elected President of the Central of New Jersey, also, at a meeting of the board of directors of that road, on April 12, succeeding Mr. J. R. Maxwell.

Mr. L. E. Butler has resigned as General Foreman of the locomotive and car department of the Missouri Pacific at Kansas City, Kan., to accept a position with the United States Metallic Packing Company, of Philadelphia.

Mr. J. A. Carney, Master Mechanic of the Chicago, Burlington & Quincy at Beardstown, Ill., is appointed Master Mechanic of the Burlington Division, with headquarters at West Burlington, Ia. Mr. A. J. Cota, Air Brake Instructor, is appointed Master Mechanic at Beardstown to succeed Mr. Carney.

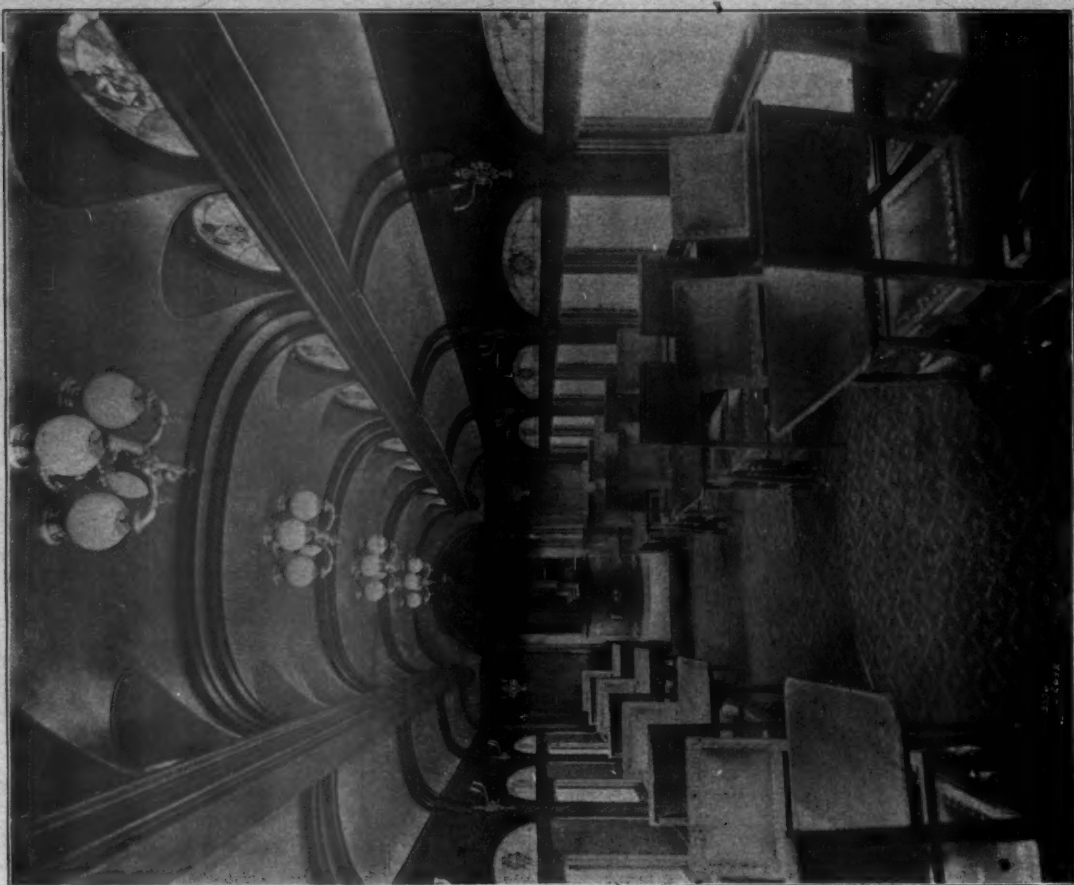
Mr. George Lovelace has been appointed Purchasing Agent and Acting Manager of the Peninsular Railway, with headquarters at Shelton, Wash., in place of Mr. A. Johnson, resigned. Mr. Lovelace was formerly Master Mechanic and is succeeded in that position by Mr. Charles A. Wiss, whose headquarters are also at Shelton, Wash.

Mr. James M. Barr, Third Vice-President of the Atchison, Topeka & Santa Fe, at Chicago, has been elected to the office of First Vice-President and General Manager of the Seaboard Air Line, and will have charge of the operation and traffic. Mr. Barr is 46 years of age and has a remarkably successful railroad experience extending over a period of 23 years.

Aldace F. Walker, Chairman of the board of directors of the Atchison, Topeka & Santa Fe, died in New York, April 12th. Mr. Walker's connection with this road began in 1894, when he was appointed receiver of the company's property. After the reorganization Mr. Walker was made chairman of the board of directors and remained in this position up to the time of his death.

Mr. James Ashworth, General Foreman of the Louisville & Nashville at Corbin, Ky., has been appointed Master Mechanic of the South & North Alabama and Birmingham Mineral divisions, with headquarters at Birmingham, Ala. Mr. J. C. Carroll, Foreman at Bowling Green, Ky., is appointed General Foreman to succeed Mr. Ashworth. Mr. Carroll is succeeded by Mr. Louis Wellisch.

Mr. F. D. Underwood, Second Vice-President and General Manager of the Baltimore & Ohio, has accepted the position of President of the Erie to succeed Mr. E. B. Thomas, who will become chairman of the board of directors. Mr. Underwood was formerly for a number of years General Manager of the Minneapolis, St. Paul & Sault Ste. Marie, and on January 15, 1899, went to the Baltimore & Ohio as General Manager, and the same year was chosen Second Vice-President.

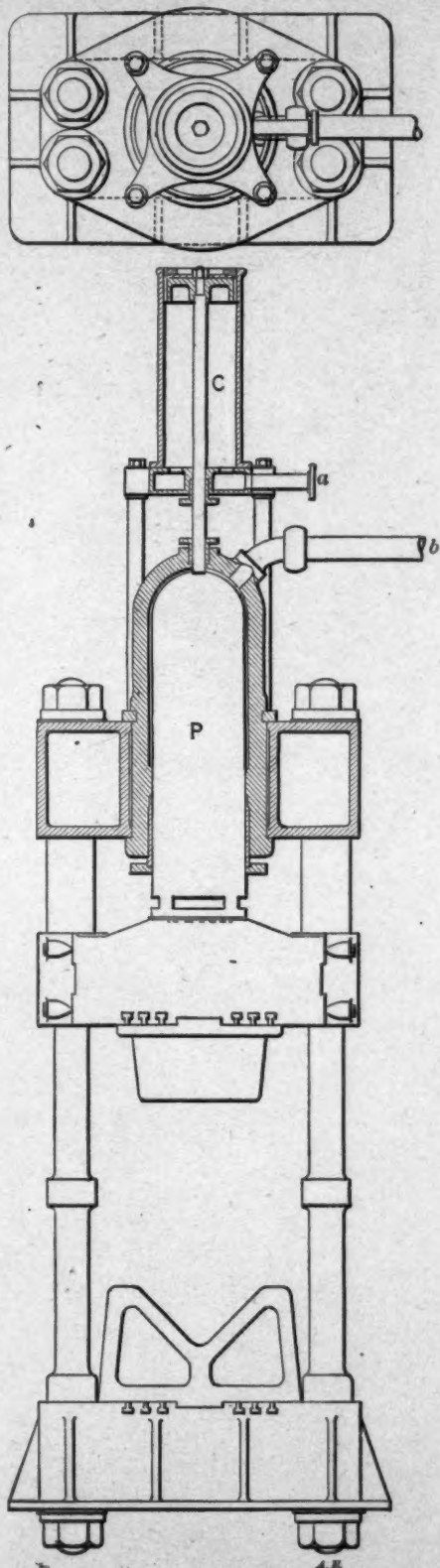


Interior Views of Dining Cars—Chicago, Burlington & Quincy Railroad.

These Engravings of the New Dining Cars for the Chicago, Burlington & Quincy Railroad, Supplement the Illustrated Description of these Cars Given on Page 116 of the April, 1901. Issue of this Paper.

HYDRAULIC SHOP TOOLS.

There is already a strong desire in railroad shops to replace steam hammers by hydraulic presses, for making large forgings. Many of the railroads are now manufacturing their own axles and the trouble experienced with such large work in the

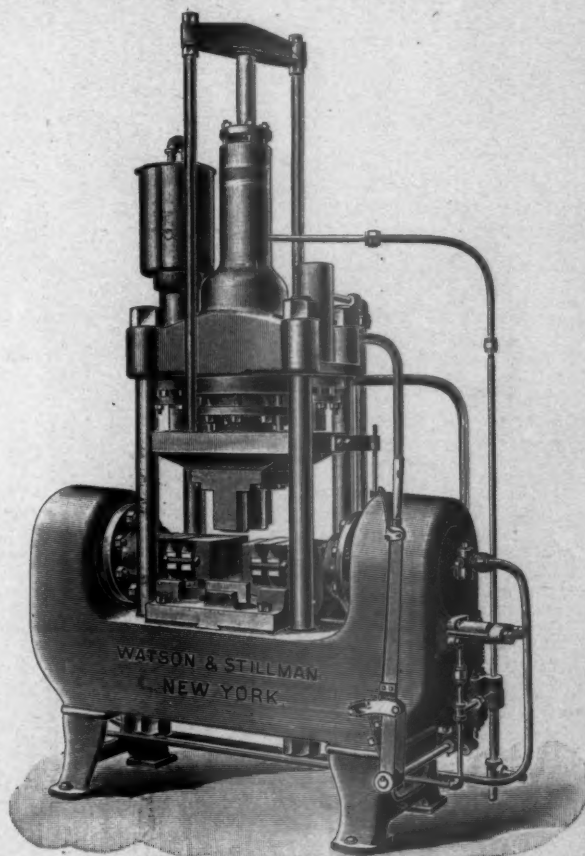


Heavy Shafting Press Suitable for Forging Axles.

use of the steam hammer is that the quick blows of the hammer affect the metal only near the surface, while the action of the press is that of squeezing, which extends through the whole mass, treating it uniformly, and the result is a much more satisfactory product. At the February meeting of the

Western Railway Club, Mr. G. S. Gillon, of New York, presented a paper on "Hydrostatic Tools in Railway Service," in the addenda of which is presented a heavy shafting press, designed by the Watson-Stillman Company, New York, in 1898, for an Eastern shop. Through the courtesy of Mr. Stillman we reproduce an engraving of this press, together with three other important hydraulic tools.

This same shafting press Mr. Stillman says is suitable for forging the standard M. C. B. axles. It was originally designed for low pressure and a long stroke, and is operated by a low-pressure pump with an air accumulator and high-pressure intensifier. The high pressure being used only on the working stroke; that is, the low-pressure pump moves the plunger to its upward position and the high-pressure acts only on the downward working stroke. The drawback cylinder marked C is single-acting, the water being forced into the cylinder through the pipe a, from the low-pressure pump, through an accumulator at a pressure of 150 lbs. per sq. in.



Triple Acting Forging Press.
With Independent Speed Cylinders.

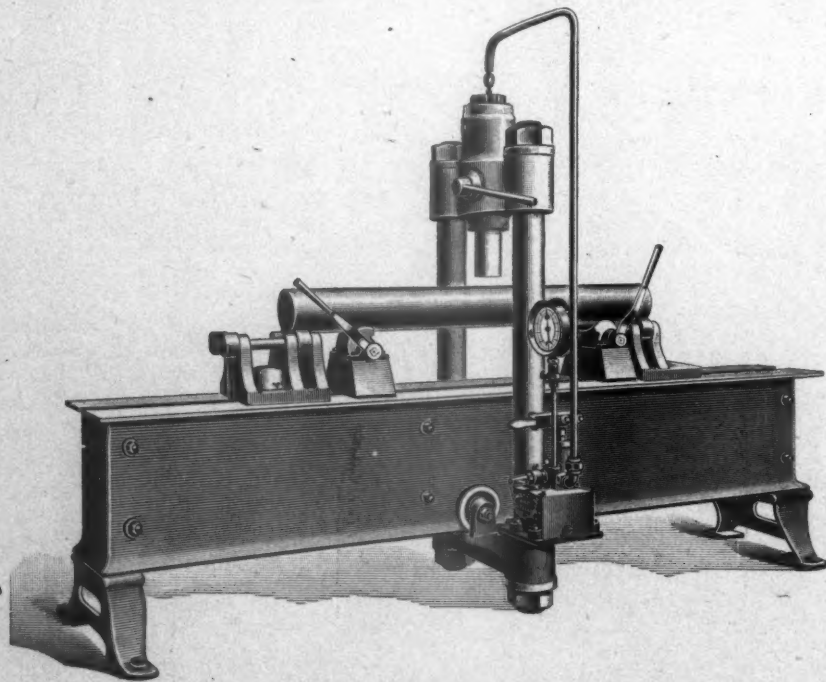
The high-pressure drives the plunger P through a stroke of 16 ins. as often as 12 times a minute and exerts a pressure of 4,000 lbs. per sq. in. on the work. A more satisfactory set of valves and cylinders for operating such a press, in which the blows of the plunger can be made as frequent as the metal can be worked, is shown in the accompanying engraving, in connection with the triple-acting forging press. The movements of the plunger are all done by low pressure, the high pressure being thrown in, as the die is brought to the work, thus making a very economical machine.

This tool is itself a most valuable one for forging and is adapted to forming a large number of small articles from sheet and bar iron. There are three drawback cylinders for withdrawing the large rams, and two small cylinders placed between the rods. Besides the large reversing cylinder, speed cylinders are provided, their use permitting the employment of one high-pressure accumulator and at the same time using very little of the high-pressure water while passing through that position of the movement requiring little power. The

usual practice has been to use both high and low-pressure accumulators. The throwing of the high pressure into the large cylinder is done automatically and controlled by a collar on the valve rod at the right-hand side of the machine. The press is governed completely by special, four-spindle, balanced governing valves. To prevent improper forming of the bottom of a piece of work by too quick closing of the side cylinders, a restricted check valve is placed in each side cylinder, thus allowing free motion of the liquid one way and restricting as much as desired of the motion the other way. The press is packed from the outside under glands, avoiding the use of leather packings, as the iron parts are liable to heat by reason of the small amount of water used. This tool has a vertical movement of 8 ins. and a side movement of 1 in., each working up to 75 tons pressure. These cylinders and valves used in operating the plunger would be very satisfactory in operating such an axle press as illustrated in this article. The automatic feature would of course be abandoned and operated by hand. The expensive parts of these presses are the valves, but a hydraulic plant complete for forging axles can be installed for about \$5,000—not more than the cost of a 5,000 or 6,000-lb. steam hammer. English roads that are now using hydraulic axle presses claim that their percentage of losses is reduced as much as 40 per cent. by their use.

Axle Straightening Press.

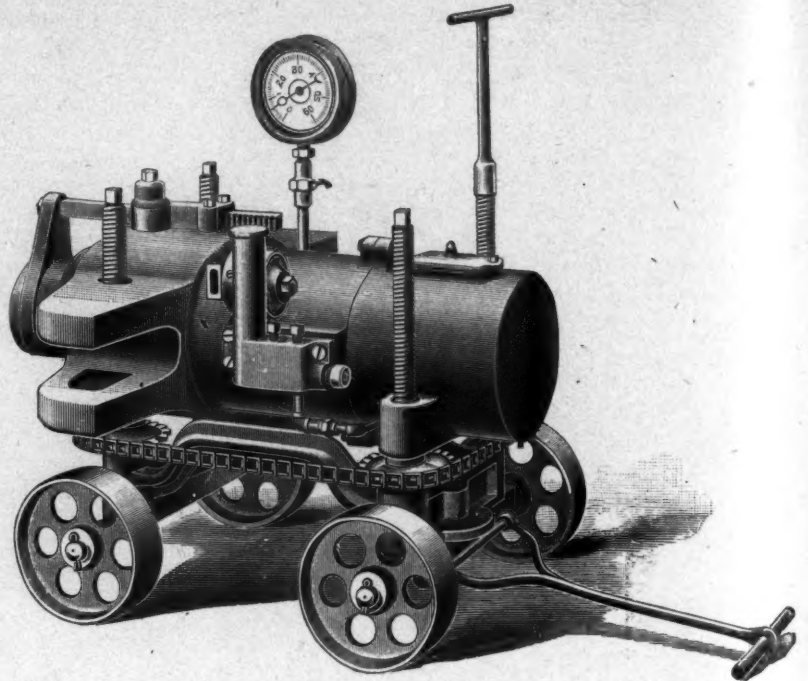
This machine is designed with a traveling frame which runs on rollers bearing on the lower flange of the beams. The arrangement of the air pump is independent of the cylinder and is located upon a bracket fastened to the traveling frame, at a height from the floor convenient for operation. The ram has a vertical movement of 4 ins. and is provided with a rack and pinion for bringing it down to the work independently of the pump. In straightening car axles, and shafting of vari-



Axle Straightening Press.

ous lengths, the bending blocks and roller stands can be adjusted to any position on the beams. The rollers, when belted, revolve the work after it is dropped on the rollers, from the bending blocks, which are mounted eccentrically and bear

solidly on the beams when receiving the bending strains. The traveling frame permits the bending of a shaft at any place between the roller frames, and by moving the work endwise, a piece twice the length of the beams can be straightened. The maximum opening with a short end on the ram is 12 in., and by changing these ends any size bar can be bent.



Improved Crank Pin Press.

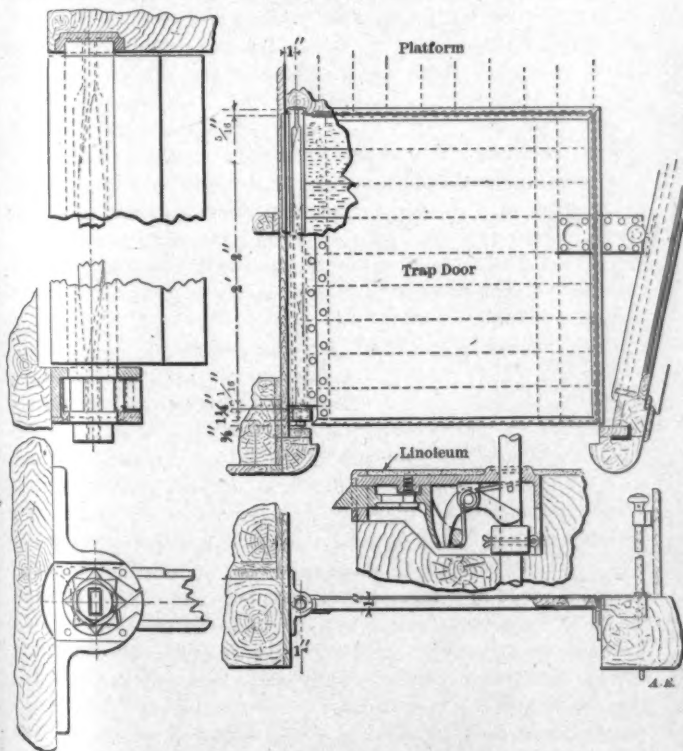
Crank Pin Press.

To do away with any chance of springing a crank pin and forcing it home out of true, the improved press, of which an engraving is shown, was designed with its tension beam as close as possible to the work. The pump cylinders are placed immediately behind the beam and are similar in operation to a horizontal jack. To adjust the plunger and cylinders to the proper height for work, a socket wrench is used to operate the four elevating screws, placed at the four corners of the truck and all operated at one time by means of a chain passing around the four sprocket wheels. A rack and pinion, at the front of the cylinder, forces the ram up to its work, and hydraulic power is applied by the pump, which is operated by a hand lever inserted in a socket of the pump, located at the center of the press. The return motion or release of the pressure is accomplished with a small key wrench, used in the release valve stem, located a little to the right of the pump. All the larger parts of the machine are steel. The valves of the pump are made metal to metal, requiring no packing, and these are situated beneath the bonnets where they can be easily taken out for grinding or examination, when it is necessary. When pressing in crank pins, no extra appliances are required in connection with the press other than two rods and a pair of washers, but in pressing out crank pins a chuck 24 ins. long and a forcing pin are necessary.

Mr. T. R. Browne, formerly of the Pennsylvania Railroad, has pointed out in his article, on the Blacksmith Shop, page 187 of our June, 1898, issue, the advantage of hydraulic forging presses over hammer work in locomotive forgings, and has also described, on page 76 of our March, 1899, issue, the action of a very useful press for small work used at the Juniata shops.

EDWARDS VESTIBULE PLATFORM TRAP DOORS.

The typical features of the extension platform trap door illustrated in the accompanying engraving are: a torsional spring for opening and closing the door, an automatic device for releasing the catch, and a hinge running the entire width of the door. The spring is composed of two equal lengths of spring steel $\frac{5}{8}$ by $\frac{1}{8}$ in. and 28 ins. long. One end of the spring is held by the hinge, while the other end is fastened in a ratchet wheel contained in a bracket which is attached to the body of the car. By means of the ratchet wheel the torsion in the spring can be regulated to any required amount, so that the door, when the catch is released, will automatically open partially, or to a full vertical position, as desired. When in the latter position the least stress is upon the springs, and as the door is closed the torsion is increased. The weight of the door serves to give an almost equal stress of spring throughout any movement of the door. The device used in operating the catch is shown in detail and in the longitudinal section through the platform and trap door. A bell crank operated by a small movement of the pull rod located at the end of the vestibule, withdraws the catch and allows the door to open. The weight



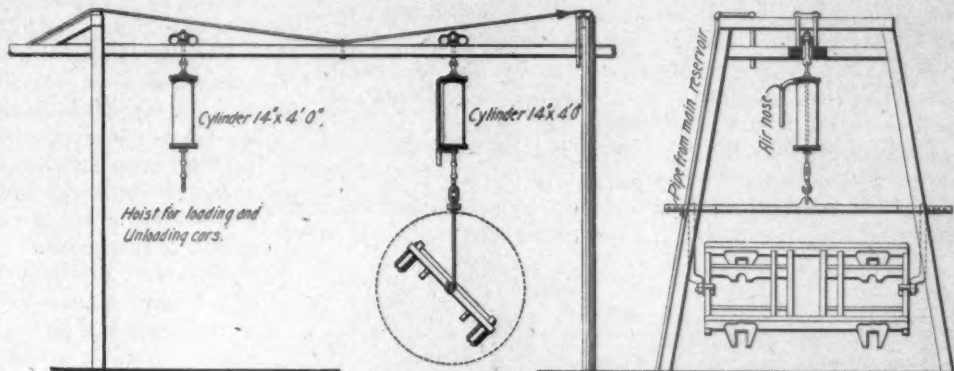
Extension Platform Trap Door.

of the pull rod, together with a spring bearing against the catch, returns it automatically to a locked position. One of several methods of applying the hinge to trap doors both with and without linoleum or rubber covering, is shown in the engraving. These trap doors have been applied to passenger cars on the Denver & Rio Grande; Southern; Ontario & Western; Atlantic & West Point; Lake Shore & Michigan Southern; Chicago, Indianapolis & Louisville; Baltimore & Ohio, and on cars now being built in the shops of the Barney & Smith Manufacturing Company, Pullman Palace Car Company and the American Car & Foundry Company. This showing speaks well for a device that has been upon the market for so short a time.

HOIST FOR REPAIRING PASSENGER CAR TRUCKS.

Lake Shore & Michigan Southern Railway.

The weight of truck frames of passenger equipment renders them exceedingly awkward to handle in the shop and they are built up of so many parts as to necessitate considerable work in overhauling. The accompanying engraving illustrates an air crane arrangement used at Cleveland at the shops of the Lake Shore & Michigan Southern, the drawing of which was received through the courtesy of Mr. W. H. Marshall, Superintendent of Motive Power. The device has been in use for several years and it has proved to be a valuable one which may be used to advantage elsewhere.



A Crane for Repairing Car Trucks.

A frame work carries a trolley bar spanning two tracks and supports two trolleys, to each of which a 14 by 48-inch air cylinder is hung. The one at the left is used for loading and unloading cars and the one at the right is fitted with a cross bar and slings, the lower ends of which are provided with swiveled clamps for supporting truck frames. These are raised by the air pressure and they may be tipped for convenience in getting at the bolts and other work on the under side of the frames. Both cylinders may be used for this work if desired. The arrangement is completed by the air hose connections and the necessary valves.

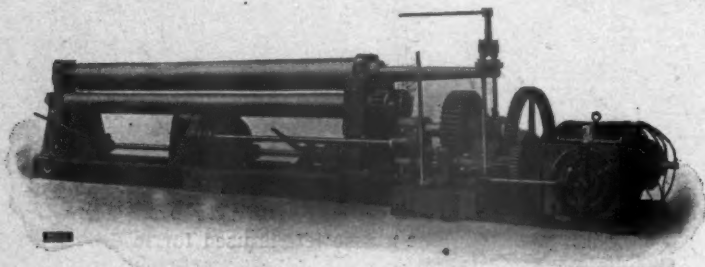
VACUUM CEMENT AND PULLEY COVERING.

The principle upon which the vacuum cement and pulley covering has been developed, is to give to a belt the quality of hugging the surface of the pulley, as this is considered more important than adhesiveness gained at the expense of corresponding resistance of the belt away from the face of the pulley in its natural line of travel. There are preparations which, while softening in their general effects, possess deteriorating agencies that harden and enamel the surface of the belt, which results in cracking and destroying the life of the leather. The Vacuum Cement and Pulley Covering Company, of 1493 Third avenue, New York, after many years of careful experiment and established record, feel able to claim the best covering in the market; a covering that prevents all belts from slipping and from which nothing comes in contact with the belt to injure it, but will prolong the life of a belt from two to three times. This pulley covering allows the use of much slacker belts and may be applied to any pulley, iron or wood, and is guaranteed for five years.

The Chicago Union Transfer Railway Company, of Chicago, have issued a notice that the switching yards of that company, now under construction in the township of Lyons, Cook County, Ill., on what was formerly known as the Stickney Tract, having connections with the Belt Railway of Chicago, the Chicago Junction Railway and the Chicago Terminal Transfer Railroad, will be known as the "Chicago Clearing Yards."

ELECTRICALLY DRIVEN BENDING ROLLS.

The plate bending rolls illustrated in the accompanying engraving are solid wrought-iron forgings having a capacity for bending plates up to 12 ft. in width and $\frac{3}{8}$ in. thick. The lower rolls are geared together, while the upper or bending roll is revolved by the friction of the plate in passing through. It is adjustable by power to suit the thickness of the plate and the radius to which it is to be bent. It has a hinged bearing at one end which may be turned down out of the way, while the other end has a long shank extending to a third support which retains the roll in position for the removal of rings or flues. This will be found a great advantage in boiler and other shops where plates are to be bent. Midway between the housings a set of supporting rollers are placed to give additional stiffness to the lower rails. For very long machines additional sets of rollers are added. The machine is firmly tied together by a heavy cast-iron sole plate. It is very strongly geared and all parts are made stiff and substantial. Suitable levers and clutches are conveniently placed for the quick and easy control of all the operations. The machine is driven by an 18-h.p. reversible, constant-speed motor, made by the Bullock Electric Manufacturing Company. For controlling the motor, an auto-



Bending Rolls Driven by Bullock Motor.

matic rheostat is used to prevent the operator from throwing on the full current too quickly and burning out the motor. The field consists of a circular yoke of special steel, with particular attention given to a reduction in weight, but this has not been at the sacrifice of efficiency. The pole pieces, built up from soft sheet steel of the highest magnetic quality, are securely bolted to the yoke. The shape of the punchings are such as to produce a saturated pole face, and this feature, coupled with carefully proportioned windings, is largely responsible for the sparkless operation of the motor. The windings, which are let into slots provided in the periphery of the armature core, are made of either copper bars or wire as best suits the requirements. The coils are machine formed, and thoroughly insulated with mica and other high-grade insulations. They are baked in steam-heated forms while under pressure, which removes all moisture and produces a perfect and very compact coil. The commutators are built from drop-forged bars of pure lake copper with selected mica insulation. They possess great durability and have an exceptionally even wearing surface for the brushes. The brush holder is simple and highly efficient, giving absolutely no trouble. It is of the reaction type; no adjustment of the brushes is necessary, and when they are once set the motor will operate in either direction without sparking and under all variations of load.

The Lehigh Valley Railroad are making extensive improvements to their Buffalo passenger station, at Washington and Scott streets, to facilitate the handling of passenger traffic to the Pan-American Exposition. Additional passenger tracks have been installed, and the capacity of the trainsheds more than doubled. The enlarged baggage room will be used solely for outgoing baggage; all incoming baggage being handled in an additional baggage room established on Scott street, adjoining the station building. To facilitate the rapid unloading of excursion trains, a 20-ft. walk has been constructed to the north of the station, projecting over the Hamburg Canal. This will obviate the necessity of having excursionists walk through the main waiting room. A commodious parcel room has been established, the space assigned to the ticket agent increased, and the improvements, now almost completed, will, it is thought, be ample to take care of the largely increased passenger business which this line expects to transact.

THE FUEL QUESTION IN STATIONARY PLANTS.

The fact that a fireman of a stationary plant may burn fuel costing from 10 to 15 times as much as his wages, the proportion varying with the locality, is sufficient reason for considering every possible means for educating him and inspiring his desire to save fuel. Mr. W. L. Abbot, of the Chicago Edison Company, in a paper before the National Electric Light Association treated this subject ably. We quote the following from his remarks on the fuel question:

The greatest possibilities for saving or wasting about a steam plant are undoubtedly in the coal pile, but as it is a dirty proposition and many of its features not well understood, the subject does not receive the consideration to which it is entitled.

The average ambitious engineer will spend much time and care on his engine to be sure that the indicator cards are perfectly symmetrical, that the points of cut-off are equal, that the release is in time and that the compression rises to meet the admission in a smooth, rounded curve. This is commendable, yet the same time spent in studying the conditions of combustion in his furnace might show him a way to make a saving in fuel fourfold greater than is possible in the final refinements of the indicator cards.

A fireman whose wages amount to, say, 20 cents an hour will burn during that time fuel costing 10 or 15 times as much as his wages. It would not be possible by any sort of driving to save half of the wages, but it is readily possible, by properly watching and instructing the fireman, to save double his wages in coal. In the first place, great care should be exercised in the selection of the coal to be used. I believe that the cheapest coal is that kind which has the greatest amount of combustible for the least amount of money, provided the furnaces are of the proper kind and ample in capacity to make the required amount of steam from them. The very cheapest kind of Illinois screenings, costing less than \$1.50 a ton, will not have less than 10,000 B. t. u. per pound, and the very best of eastern lump, costing \$4 a ton, will not have more than 14,000 B. t. u. per pound. This means, then, that for equivalent heating qualities the cheapest screenings cost about half as much as the high-grade coal.

Having selected the coal, the next problem is how to burn it properly. It is commonly understood that 12 lbs. of air are needed to properly burn 1 lb. of coal. It is also commonly supposed that in practice about twice this amount of air passes through the fire, but just how much actually passes and under what conditions are the best results obtained are impossible to determine without making analyses of the flue gases. Fortunately, this has now become a very simple operation and one which can be performed and understood by anyone competent to take charge of a large boiler room. These tests often show the most surprising and disappointing results. The analyses are made to determine the percentage of carbon dioxide in the flue gases. Under perfect conditions it can run as high as 20 per cent., but it is not unusual to find samples running as low as 2 per cent. of dioxide. This brings down the economy for two reasons: First, the gas in the firebox is diluted with an excess of cold air and cooled down, and, secondly, the amount of gas, being increased in volume, passes through the boiler more rapidly and does not give up so much of its heat. It is almost a paradox that within reasonable limits the more the gases are cooled down in the furnace by the admission of excess of air the hotter they will pass away from the boiler. The two causes of excess of air in the flue gases are, first, running boilers on too light loads, and, secondly, careless firing.

To follow intelligently the work of the individual fireman, we have installed in our boiler room a device through which is induced a small current of gas from the boiler breeching. The weight of this gas, changing with its composition, moves a pointer across a dial, thereby indicating continuously the

varying percentage of carbon dioxide in the flue gas. From this device are run individual pipes to the breeching of each boiler, and all is so arranged that samples may be drawn from several boilers and tested in a few minutes, or a continuous test may be made of the performance of any one boiler. Readings taken from this instrument at regular and short intervals, when plotted, form a curve which is a very comprehensive record of the conditions of combustion during the time of observation.

EIGHT-POLE MOTORS AND GENERATORS.

The motors of this type as manufactured by the B. F. Sturtevant Company, of Boston, Mass., and illustrated in the accompanying engraving, were primarily designed for direct-connected driving of large fans at low rotative speeds. They are therefore capable of great range of speed, and are exceptionally compact and of high efficiency. These qualities especially fit them for direct connection to machine tools. The magnet frames are of cast steel, cast iron or wrought iron, according to size or requirements. In the smallest size the field cores are cast with the frame, and the pole shoes only are removable, but, in the larger sizes readily detachable cores of wrought iron are bolted to the frame. The armatures usually employed are barrel-wound, of the toothed-hollow drum type. The laminations are of special steel plate mounted in each case upon a cast iron spider, the hub of which is extended to support the commutator. All machines except those for very low speed and high voltage are bar wound; the two-circuit type being usually adopted. This makes possible the use of a single pair of brushes where only small brush capacity is required. These machines are built in sizes from 1-100 to 50-100, the ratings being based on the horse-power delivered per 100 revolutions. The eight-pole generators are the same in design as the motors of the same type and in the larger sizes the shunt and series coils of the field windings are wound and insulated entirely separate. The brush-holder rigging for supporting the holders is so arranged that brushes of opposite polarity are carried on independent rings, which are attached to, but insulated from, a common ring which is readily detachable. On a small machine the adjustment is by hand, and on a large machine by means of a hand wheel and screw. The self-contained character of the armature and commutator especially fits both the motors and generators, to any piece of apparatus; the generators being particularly adapted for engine driven sets. The large radiating surface and thorough ventilation makes it possible to run these machines at full speed with a maximum rise in temperature not exceeding 30 degrees Cent. on the hottest part. All sizes are provided with self-aligning, ring-oiling bearings, those sizes below the 15-100 motor being supported in tripod hangers, while the larger sizes are equipped with pedestals and complete bases. The generators, like the motors, are built in ten sizes, ranging in capacity from 3 kw. to 100 kw.

Mr. C. S. Morse has been appointed Superintendent of Motive Power and Cars of the Wheeling & Lake Erie, with headquarters at Cleveland, O., vice Mr. J. B. Braden, resigned.

TRACK ARRANGEMENTS IN ERECTING SHOPS.

Crane service and the track arrangement of shops for erecting locomotives, and, in fact, the entire question of shop plans now receives more attention than it has ever had before, and the subject of shop arrangement is before many motive power officers who are thinking of prospective new work of their own in this direction. The relative merits of longitudinal and transverse track arrangements occupy attention during the earliest stages of the planning, and we have given considerable space to the views of those who have strong preferences on either side. We are inclined to think that the advocates of the longitudinal tracks and the substitution of the best crane service for the transfer table have the better side of the arguments, and in confirmation of this the following quotation is made from a communication signed "R. H. S." (Mr. R. H. Soule is believed to be the author) in a recent issue of the "Railroad Gazette":

"The suggestion that new shops may be erected on present transfer table locations is meritorious, especially for locations where new ground is not available. I am inclined to believe



The Sturtevant Eight-Pole Motor and Generator.

that with the modern tendency to concentrate shops and locomotive repairs, the longitudinal type of locomotive repair shop will win more advocates, as time goes on, and the transverse system will be reserved for use at points where but few locomotives are handled. One advantage in the longitudinal system which I have not hitherto seen mentioned, is that each engine need only take track room suitable for its length; whereas, in the transverse system each engine must monopolize a pit or stall, and the stall tracks must necessarily be long enough for the longest engine in use at the time the shop was designed, with preferably an excess of length to provide for possible increases. One defect in the longitudinal system is that the desire to keep down the span of the traveling cranes has resulted in leaving the shop too narrow for convenient working, and for the storage of materials.

"The use of long buildings, as in recent English practice, may easily be justified, but the advantage of uniform span and uniform roof trusses should not be allowed to prevent the

use of such a particular span for each building as best promotes the economical handling of the work in that building.

"The arrangement of the new Oelwein shops of the Chicago Great Western challenges attention from the fact that unusual duty is imposed on the transfer table, which seems to be the key to the situation; and the question has been raised whether the work of the different departments may not at times be delayed waiting for transfer table service."

BOOKS AND PAMPHLETS.

Pacific Tours and Around the World. Journeys via the American and Australian Line. By Trumbull White. Issued by the Passenger Department, Santa Fe Route. Pamphlet form, fifteenth thousand, 206 pages, 8 x 5 1/4 ins., 323 illustrations and 12 maps. Printed by Rand, McNally & Company, Chicago, 1901.

This very instructive, interesting and beautifully illustrated book of journeys is issued for the purpose of attracting wider attention to the pleasures of 'round the world travel, and with a view of answering such practical questions as would naturally come to one contemplating a journey to Hawaii, Samoa, Fiji, Tahiti, New Zealand, Australia, China, Japan, the Philippines, East Indies, India, Egypt, the Holy Land, Africa, the Mediterranean, Europe and South America. It is a little surprising to know with what ease the most remote regions of the world can to-day be reached and with comforts quite as wholesome as those we have at home. All these facilities of modern travel have been placed at the command of the traveler at a comparatively small expense by the American and Australian Line, composed of the Atchison, Topeka & Santa Fe Railway system for the transcontinental journey to San Francisco, and the Oceanic Steamship Company, of San Francisco, and the Union Steamship Company, of New Zealand, from San Francisco to the other side of the world. The descriptions of the various tours offered are from the viewpoint of an American traveler and are very attractively, yet apparently truthfully, written. A great many privileges are offered to passengers purchasing through tickets, which are furnished from any point to another on this circuit around the world and at a great saving in cost to passengers buying a through ticket, instead of booking from point to point. Those who are fortunate enough to procure a copy of this book from Mr. G. T. Nicholson, Passenger Traffic Manager of the Atchison, Topeka & Santa Fe Railway systems, Chicago, will find it one of the best books of tours that has been issued.

Steam Boiler Economy. A Treatise on the Theory and Practice of Fuel Economy in the Operation of Steam Boilers. By William Kent, A. M., M. E., Consulting Engineer, Associate Editor of "Engineering News." 8vo, 458 pages, 126 illustrations. Price, \$4. Published by John Wiley & Sons, 43 East 19th street, New York, 1901.

This book treats of steam boiler economy and the subjects relating to economy. Mr. Kent is a well-known authority on this subject and is qualified by training and experience to prepare a book of this kind. It contains not a little information which is not available elsewhere. Because the author has collected from his own writings and those of others a great deal of information which is scattered and not to be easily found, this work will be found exceedingly convenient. It is such a book as one would expect from the author of the Mechanical Engineer's Pocket Book. The style is direct and concise and the chief object of the author was to meet the need for a discussion of questions of economy for steam users. To engineers its greatest value lies in the treatment of fuels and the details of combustion, including the effectiveness of furnace arrangements and heating surfaces. Its scope is very wide, as indicated by the headings, which are: Principles and definitions, fuel and combustion, coal and coal fields at home and abroad, fuels other than coal, furnaces, methods of firing, smoke prevention, mechanical stokers, forced draft, elementary principles of boiler economy, efficiency of heating surfaces, types of boilers, horse power and performance of boilers, the points of a good boiler, boiler troubles, evaporation tests, results of trials,

properties of water and steam and miscellaneous subjects. The treatment of the chemistry of fuels and the temperatures of combustion is more complete than we have seen in print before. The author's experience in the study of different fuels has been specially broad and this led him to enter thoroughly into the effects of different kinds of fuels on economy. He reviews the work of other authorities on fuel, such as Lord and Haas, Johnson, Scheurer-Kestner, Mahler and Bunte, including American and foreign coals. In the discussion of boilers the plain cylindrical boiler is taken as representing the simplest form and the author shows the relation between economy and the rate of driving. This is done in an elementary way and also mathematically including the first appearance of a formula for the efficiency of heating surface which includes the heating value of the fuel, the temperature of the water in the boiler, loss by radiation, weight of chimney gases per pound of combustible and the rate of driving. Thus all the measurable variables are included. In this Mr. Kent's chief idea is developed, viz., the comparison of results of tests of different boilers upon a really fair basis. Those who purchase and use steam boilers will derive valuable information from Chapters X. to XIII., treating of horse power, grate and heating surface proportions, the "points" of a good boiler and boiler troubles. The author gives a most sensible view of the selection of boilers. He illustrates the accepted types, all of which are good. The closing or miscellaneous chapter includes a discussion of the design of a power house plant for a small street railway and the cost of coal per boiler house power per year, with various prices of coal. The author comments upon the chaotic state of boiler practice and believes that the survival of a type will depend more upon practical questions, such as safety, maintenance, flexibility and the possibilities of forcing than upon economy because the ultimate possibilities of the economy of all types are alike. Mr. Kent believes that we now have enough types of boilers and does not expect to see new ones developed. The development in the direction of combustion of soft coal without smoke he considers the greatest improvement to be made in the future and he considers the intimate admixture of very hot air with the distilled gases the most promising method of raising the efficiencies of boilers. He advocates the use of automatic stokers and furnaces surrounded with firebrick. In the description of his "wing wall" furnace the author presents the ideal furnace conditions for economy and smokelessness. He would not attempt to prevent the formation of smoke, but by intermixture with hot air in the furnace would consume it. On page 157 the principles of smokeless combustion are clearly stated. There is scarcely a subject concerning combustion, including oil and powdered fuel, which the author has not included. The book is commended. We do not find any serious faults, although the index is somewhat disappointing.

The American Sheet Steel Company have issued a new card giving weights of the "Appolo Best Bloom" galvanized sheets. This card shows the weight of these sheets, number of sheets in a bundle and the weight per bundle in all the standard sizes and gauges from No. 10 to 30 inclusive. Copies of this card will be sent to those who will address the advertising department of the American Sheet Steel Company, Battery Park Building, New York.

A third edition of Walter B. Snow's lecture on "The Influence of Mechanical Draft Upon the Ultimate Efficiency of Steam Boilers" has just been issued by the B. F. Sturtevant Company, Boston, Mass. It treats of the different methods of application of fans for producing boiler draft, of the relative cost as compared with a chimney, of the possible economy in first cost of boilers, running expense for fuel, etc. Copies may be obtained upon application.

Log Book of the California Limited.—The Santa Fe Route has just issued the fifteenth thousand of a very attractive and artistically prepared pamphlet giving the impressions of the traveling public, journeying to California by the way of the California Limited. These impressions are from every viewpoint of the traveler. The book is interesting and somewhat out of the ordinary in the number of nice things said, for it is more common to hear the public finding fault with rather than praising a railroad.

Disc and Propeller Fans.—The B. F. Sturtevant Co., Boston, Mass., have just issued a small illustrated catalogue of their disc and propeller fans, to fill a field of service requiring low velocities and slight resistances. This catalogue is No. 116.

The decisions of the Arbitration Committee, Nos. 1 to 603 inclusive, of the Master Car Builders' Association, have been reprinted in a volume of 711 pages with index; bound in cloth similar to the reports of the proceedings. These decisions are now ready for distribution and may be procured from the Secretary, Mr. Jos. W. Taylor, 667 Rookery Building, Chicago. The price of the book is \$1.50 and postage.

Tools and Supplies for Machinists and Metal Workers.—The Hammacher, Schlemmer & Co., New York, have issued two very desirable catalogues, one on tools for machinists and metal workers and the other on bolts, screws and supplies. The latter book is No. 114 and presents a complete line of bolts and screws for all purposes and includes such other matter as descriptions, sizes, contents of packages, etc., the knowledge of which is necessary to the intelligent ordering of such goods. While this company manufactures everything in the line of factory supplies, it has not been the purpose to give in this catalogue a complete list of these supplies, but to include only such items as are generally demanded in a moderate way with bolt and screw orders. In catalogue No. 115 is presented a complete line of tools such as are ordinarily used by machinists and metal workers. All sizes of these regular goods are carried in stock and this company is particularly well-equipped to handle large orders in the best possible manner, and for all items whether shown in the catalogue or not, they solicit inquiries. These catalogues may be had by writing to Hammacher, Schlemmer & Co., 209 Bowery, New York.

EQUIPMENT AND MANUFACTURING NOTES.

The Baldwin Locomotive Works have orders for 108 large freight engines from the Pennsylvania Railroad Company.

The Pressed Steel Car Company, of Pittsburg, Pa., has received an order for pressed steel body and truck bolsters for 1,000 freight cars now being built by the Pullman Company for the Rutland Railroad. Of these, 750 cars are of 60,000 lbs. capacity and 250 of 80,000 lbs. capacity.

Mr. Charles H. Duell, Commissioner of Patents, has resigned that office to resume the practice of law. He will have associated with him Mr. William A. Megrath and Mr. Frederic P. Warfield, under the firm name of Duell, Megrath & Warfield, with office in the St. Paul Building, 220 Broadway, New York. Mr. Megrath has been connected with the patent office for fifteen years, and for the last seven years has held the position of law clerk to the commissioner. Mr. Warfield has been an assistant examiner for several years. Special attention will be given to the practice of patent, trade-mark, copyright and corporation law.

Experience has clearly demonstrated that in this climate no system of ventilation can be successfully operated by itself and independently of the method of heating that may be adopted. It is, in fact, a vital element of success that the two systems be most intimately combined, for they are clearly interdependent, and when properly applied are so interwoven in their operation and results that disunion is certain to bring about failure. For the purpose of ventilation the fan was first applied upon a practical scale about the middle of this century, but only to a limited extent, and it was not until the fan and the steam heater in marketable form were introduced by B. F. Sturtevant, of Boston, Mass., that the so-called "Blower System" became a reality. The system, of which these two elements are the most important factors, as originated by this house, has naturally been known as "The Sturtevant System." This system is at once practical, successful and economical; for, air being the natural conveyor of heat, it may, when properly warmed and supplied, perform the double office of heating and ventilating. As applied, the Sturtevant system forced the air into the apartment by the pressure or plenum method.

The Browning Manufacturing Company, of Milwaukee, Wis., have moved into their spacious new factory, which has been built to meet the urgent demands of increasing business. This company considers the matter of sizes of units, in electric driving, a most important one and has given a great deal of attention to the sizes of motors for individual machine driving and the relative capacities of generators for this style of driving in different kinds of shops. As a result they are building a line of high-grade motors and generators from $\frac{1}{2}$ to $3\frac{1}{2}$ h.p. that cover the entire range required. The new plant is running 22 out of every 24 hours, which is evidence of the demand for the Browning Company's product.

Mr. J. R. McGinley, who has for nearly twenty years been prominently identified with the Westinghouse interests, has purchased the entire capital stock, factory and real estate of the Duff Manufacturing Company, of Allegheny, Pa., and will take personal charge of the management of the Duff Company. A number of improvements will be made in the factory that will greatly increase the capacity of the present plant. Arrangements are also being made for the sale of the company's products in foreign countries.

The Keasbey & Mattison Co., owners of the patents for magnesla covering, have commenced a suit in the United States Circuit Court for the Southern District of New York, against the Philip Carey Mfg. Co., George D. Crabbs, J. E. Breese, Schoellkopf, Hartford & Hanna Co., J. F. Schoellkopf, Jr., James Hartford, W. W. Hanna, C. P. Hugo Schoellkopf and Jesse W. Starr, to restrain the defendants from making and selling magnesla covering for boilers and steam pipes containing more than 50 per cent. of magnesla, and especially coverings containing 85 per cent. of magnesla. The Keasbey & Mattison Co. respectfully request that all persons refrain from purchasing covering infringing these patents, as such purchasing must of necessity lead to suit.

Among the interesting exhibits at the Pan-American Exposition at Buffalo will be that of the Pressed Steel Car Company of Pittsburgh, Pa. This exhibit will be in the Railway Exhibit Building, located at the north end of the fair grounds, a short distance from the plaza and electric tower. It is through this building that all persons landing at the terminal station will gain access to the fair. This exhibit will occupy 200 linear feet of track space and will consist of five cars showing various types designed and built at the company's plant. The box car will be utilized as a booth and office, and will be comfortably fitted up for the accommodation of visitors. The general dimensions of these cars are as follows: Box car with steel underframing; capacity, 70,000 lbs.; weight, 36,300 lbs.; length over end sills, 36 ft. 4 $\frac{1}{4}$ ins.; width over side sill, 8 ft. 9 $\frac{1}{4}$ ins.; height from top of rail to top of running board, 12 ft. 8 ins. Fox pressed steel pedestal trucks; cast iron chilled wheels; open-hearth steel axles; Westinghouse air brakes; American type M. C. B. automatic couplers. This car is similar to the box cars of the Erie Railroad, illustrated in this issue. There will also be a steel hopper car; capacity, 80,000 lbs.; weight, 33,925 lbs.; length over end sills, 31 ft. 6 ins.; width over side stakes, 10 ft.; height from top of rail to top of body, 9 ft. 10 ins.; pressed steel diamond trucks; cast iron chilled wheels; open-hearth steel axles; New York air brakes; pressed steel brake beams; Schoen standard twin spring attachment draft rigging; Janney couplers. Hopper ore car; capacity, 100,000 lbs.; weight, 28,500 lbs.; length, 24 ft.; width, 8 ft.; height, 9 ft. 6 ins.; pressed steel diamond trucks; Bryan draft rigging; Chicago coupler. Pressed steel flat car; capacity, 100,000 lbs.; length over end sills, 40 ft.; width over stake pockets, 10 ft.; height from top of rail to top of floor, 3 ft. 10 $\frac{1}{4}$ ins.; pressed steel diamond trucks; cast iron chilled wheels; open-hearth steel axles; Westinghouse air brakes; pressed steel brake beams; Gould couplers. Pressed steel flat bottom gondola car with twin hoppers; 95,000 lbs. capacity; weight, 34,000 lbs.; length over end sills, 37 ft. 6 ins.; width over side sills, 10 ft. 2 $\frac{1}{4}$ ins.; height from top of rail to top of body, 7 ft. 5 $\frac{1}{4}$ ins.; depth of car body, 3 ft. 11 ins.; pressed steel diamond trucks; cast iron chilled wheels; open-hearth steel axles; Westinghouse air brakes; pressed steel brake beams; M. C. B. draft rigging.

The Norfolk & Western Railway have placed an order with the Richmond Locomotive Works for ten 21 by 30-in., class "W" consolidation locomotives, which are exact duplicates of the ten locomotives which are now being built at these works. The engines will weigh, in working order, 110,000 lbs. The cylinders are 31 by 30 ins. and the driving wheels 56 ins. in diameter, with a driving wheel base of 15 ft. 6 ins. and a total wheel base of 23 ft. 11 ins. The capacity of the tanks will be 5,000 gallons of water. The two 10-wheel locomotives just ordered from the Richmond Works by the California Northwestern Railway will have each a total weight of 144,000 lbs., of which 88,400 lbs. are on the drivers. The cylinders are 18 by 24 ins. and the driving wheels 56 ins. in diameter, with a driving wheel base 12 ft. 4 ins. and a total wheel base of 22 ft. 8 ins. The boilers are 56 ins. diameter with 215 2-in. tubes 12 ft. 11 ins. long. The firebox is 96 by 34 ins. and the tank capacity 3,500 gallons of water.

AMERICAN SCHOOL OF CORRESPONDENCE.

The modern development of machinery along all branches of engineering and industrial activity calls for a continually increasing grade of intelligence on the part of the individual workman. Each year the steam shovel, the electric motor and the improved machine shop equipment take away in part the physical burdens of the workman, while they place upon him a growing load of responsibility. The workman becomes less and less a mere system of muscles and should become more and more an intelligent agent of his employer. The technical schools provide admirably for the education of the designing and constructing engineer, but make no provision for the mechanic, the foreman, the practical man who remains in charge of engine and boiler rooms after the installing engineer has finished his work and the plant is in running shape. So it happens that many an important manufacturing or power plant is in the hands of employees who have little if any real knowledge of the design and construction of the machinery for which they are accountable. Such men are necessarily cheap men, for lack of the education which would give them greater wage-earning power. They are also the most expensive men, to their employers, since they lack the knowledge which would enable them to get the best results out of boiler, engine, electric generator and all the other factors in power development. To reach and educate these practical working men in ways which will add at once to their value to their employers, and hence to their wage-earning power, is the chief aim of the correspondence system of instruction. It is not suggested that this system is to take the place of a technical college education in any case where such a course is available; but to those who cannot attend technical schools this system brings the necessary practical instruction in brief, pithy lessons, carefully stripped of all unnecessary theoretical details. The American School of Correspondence, of Boston, Mass., issues sets of instruction papers and books, covering thoroughly the practical details of stationary, electrical, mechanical, marine and locomotive engineering. These courses are prepared by trained instructors of the best standing and are well illustrated. By devoting the spare minutes of each working day to the successive lessons of such a course, the student speedily advances until he has qualified himself for the diploma, which is given upon the satisfactory completion of the work. Whenever difficulties arise in following the courses of instruction, the student writes to the instructors of the school stating the points in question, and receives prompt replies, embodying full answers to his inquiries. This system of direct, personal correspondence between teacher and pupil is continued throughout the course. Many thousands of wage-earners have availed themselves of the opportunity afforded by correspondence schools and there is reason to believe that a system that follows so closely the needs of the workingman will have a still more rapid development in the future. The American School of Correspondence now has among its pupils a considerable number in foreign countries—Great Britain, India, Africa and New Zealand are largely represented. More significant still of the scope and standing of the school is the fact that among its pupils are a large number of graduates of the foremost colleges in the United States who are taking this means to add to their college training such lines of work as were not covered by their collegiate work.

Among the devices specified for the 32 new passenger cars for the Atchison, Topeka & Santa Fe Railway is the Pintsch Lighting System. This railway has conducted many experiments with other systems of car lighting, and the fact that it has been decided to use Pintsch light on these new cars is evidence of good opinion of the reliability and practicability of the compressed gas system. With these new cars in service the Atchison, Topeka & Santa Fe will have in all 106 passenger cars equipped with the Pintsch light.

The fire which visited the works of the B. F. Sturtevant Company at Jamaica Plain, Mass., April 14th proved to be far less disastrous than was first reported. Only the engine and electrical departments were injured. The power plant was started up after a delay of but one day, incident to renewing belts damaged by fire, and the entire blower, heater, forge, galvanized iron and shipping departments with the foundry and pattern shop were in full operation on that day and the shipments going forward as usual. The most serious damage occurred in the advertising department, where a large amount of printed matter was destroyed. Fortunately, however, an entirely new general catalogue was in press at the time and copies were issued on the 16th in time to meet all demands for information. New offices were established on the morning of the 15th in a nearby building and by noon the business was running as usual. With these facilities at its disposal there is no likelihood of any delay in shipments except such as may occur in the electrical and engine departments, and arrangements are already made for handling this work.

The Bullock Electric Manufacturing Company has acquired control of 15 acres of land directly opposite their present plant at East Norwood, Ohio, upon which the Norwood Foundry Company will erect a foundry building 200 by 150 ft.; a pattern storage house, 50 by 150 ft., three stories high; and a modern office structure. All of these buildings will be built of buff pressed brick with steel frames and trusses to conform to the present buildings of the Bullock Electric Manufacturing Company. The foundry will be equipped with three electric cranes, the largest of which will have a capacity of 50 tons. The side bays, which will be 25 ft. in width, will be served by hand traveling and jib cranes. The plant will be of the most modern character, and electricity will be used for power and lighting throughout. This foundry will be operated under the name of the Norwood Foundry Company, under the direction of Messrs. Hoffinghoff & Lane, of Cincinnati, but will serve primarily the needs of the Bullock Electric Manufacturing Company. The Bullock Company have also effected a combination of their selling organization with that of the Wagner Electric Manufacturing Company, of St. Louis. These two companies manufacture entirely different products, but where the product of one is used the other is likely to be necessary. The product of Bullock Company consists of a complete line of direct and alternating current machines, from a ½-h.p. motor to a 10,000-kw. generator, controllers of various types and rotary transformers. The product of the Wagner Electric Manufacturing Company covers a full line of static transformers of all types and of the largest sizes; ammeters, voltmeters, indicating wattmeters, switches, switchboards for all purposes and single-phase self-starting alternating current motors. By thus combining the forces of the two companies, they are mutually benefited, and the lines are admirably adapted to be sold by one organization, which will be under the management of Mr. E. H. Abadie, formerly Sales-Manager of the Wagner Company.

Wanted.—Copies of the American Engineer and Railroad Journal for 1900. One copy of January, one of February, two of March and one of April. Fifty cents will be paid for each sent to the Editor, 140 Nassau Street, New York.

POSITION WANTED.

Mechanical engineer with five years' experience with two prominent railroads desires position as mechanical engineer or chief draftsman. Technical graduate in both mechanical and electrical engineering. Best of references. Address "Engineer," care editor American Engineer and Railroad Journal, 140 Nassau St., New York.